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CONTENTS

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Buzzard Farquhar (1943) *Practitioner*, **151**, 129

Grotjahn A (1923) *Soziale Pathologie*, 3rd edit., Springer, Berlin.

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BIOLOGICAL FACTORS AFFECTING FAMILY SIZE

BY

F A E CREW

Latterly much attention has been attracted, and rightly so, to the number, variety, and potency of the socio-economic factors which strongly incline married couples deliberately to restrain their fertility and thereby to limit the size of their families A tendency to overlook a number of purely biological factors which work in the same direction is to be discerned These latter are for the most part not under the control of the will of the individual and are as yet far beyond the powers of the medical and social sciences in application It is not suggested that these factors, as judged by their effects, play as important a role in determining family size as do the socio-economic, or that pronatalist policies are mistaken when based on the demonstrably reasonable assumption that if only the people could be persuaded to unleash their fertility the total size of our population could easily be maintained at its present level or even enlarged Nevertheless, it is surely desirable when population policies are being fashioned that all and not merely the more potent factors known to affect fertility shall be taken into account

Impaired Fecundity as a Limiting Factor

As the outcome of the experience of sterility, family planning, and similar clinics and of medical practitioners and specialists, and as the result of a number of specific enquiries, there has accumulated a mass of information of a scientific kind concerning the incidence of childlessness and of small family size (one or two offspring) among long-married couples There is general agreement concerning the following conclusions (see Lane Roberts and others 1939 Barton and others, 1943 Engle 1946 Editorial *British Medical Journal*, 1946, DeLee and Greenhill 1947 Whelpton and Kiser 1948 for example)

Not less than 10 per cent of all marriages in this country as also in the United States of America remain permanently fruitless Matthews Duncan arrived at the same conclusion in so far as this country was concerned as long ago as 1884 This barrenness cuts right across the social stratification it is only very exceptionally deliberate and in the overwhelming majority of instances it is due to persistent infecundity on the part of one or other of the married partners Those who state so confidently that of the marriages initiated each year one in every ten is destined to remain permanently fruitless do not indicate the route they travelled to reach this conclusion Nevertheless, there is much which would seem to give it credence Thus, of all the married women (excluding the widowed and the divorced) whose deaths were registered in Scotland during 1945

563 (25 1 per cent) though married for 10-14 years died childless
667 (21 7 per cent) though married for 15-19 years died childless
1,719 (19 7 per cent) though married for 20-29 years died childless
2,163 (12 1 per cent) though married for 30-39 years died childless

But a certain caution must be exercised when labelling a marriage as being permanently barren whilst the partners are still alive and the woman still menstruating for in Scotland in the same year of the 88,612 women who produced offspring

32 had their first child after 20— years of marriage
142 had their first child after 15-19 years of marriage
444 had their first child after 10-14 years of marriage

The same caution is demanded when an unexpected first pregnancy in an ageing woman follows immediately and dramatically upon the desperate trial of some new medicament or therapeutic system or occurs as a startling sequel to the adoption of a child However whatever the exact proportion of permanently barren marriages may be it remains a most disturbing and challenging thought that a very considerable number of such marriages do occur each year and that furthermore very large numbers of married couples, having produced one or two children thereafter remain unable to produce any more however ardently they may wish to do so This lowered fecundity on the part of either the male or the female partner is responsible for the relative infertility exhibited by some 60 to 90 per cent of small family couples There is much evidence which is continually being reinforced that after the first or second pregnancy the power of many pairs to reproduce shows a definite tendency to

The ascertained and suspected co-

infecundity are numerous for example, in the female, major degrees of uterine hypoplasia, cervical erosion, tuberculous endometritis and salpingitis, uterine retroflexion, occluded tubes, certain of these conditions often being the sequelae of a previous abortion or pregnancy, in the male, ozoospermia, oligozoospermia, necrozoospermia, asthenozoospermia (possibly associated with a deficiency of the enzyme hyaluronidase so that the follicle cells surrounding the ovum are not dispersed), sometimes the sequelae of cryptorchidism, mumps, gonorrhoea, or non-specific epididymitis Of the male partners examined on account of the infertility of a married pair, at least one in five shows abnormality of the spermatozoa of one kind or another Infrequent coitus is regarded by some as a cause of infecundity in the male and abnormal utero-tubal irritability as a cause of the same condition in the female Inability on the part of the spermatozoa to penetrate the interface between semen and cervical mucus has been shown to be causally related to infertility (Barton and Wiesner, 1946, 1948) Hormone imbalance in either sex is commonly blamed (Christie Brown, 1948, for example) It has been suggested that antibodies can be elaborated in the blood of the female partner as a reaction to hyaluronidase and that these antibodies can prevent conception by precluding the action of the enzyme upon the follicle cells (Rothschild, 1947)

Though some gynaecologists of wide experience present the view that the artificial deferment of pregnancy leads to infertility (see Siegler, 1945, for example), the great majority of studies of this matter (see Barton and others, 1943, Whelpton and Kiser, 1948 Dickinson and Morris, 1941, for example) would seem to show quite clearly that the use of contraceptive practices (other than those involving intrauterine appliances) in the earlier years of marriage has no discernible effect upon the fecundity and fertility of couples who later decide to have children

It seems to be agreed that in a very large proportion of barren or small-family marriages no physical cause for the infertility is to be identified It is not surprising, therefore, that attention, somewhat timid in nature is now being paid by gynaecologists to the possibility that psychological factors are operating to a degree previously unsuspected Thus Stallworthy (1948) having called attention to the possible significance of functional or intrinsic dysmenorrhoea vaginal spasm, vaginismus, functional bleeding and amenorrhoea, plucks up his courage and with the air of one expecting professional ostracism as a reward for daring asks whether it is not possible that a woman may deprive herself of the conception she desires or fears because of the very strength of her desire or of her fear Walser (1948) goes further He records that some 30 per cent of those who attend the sterility clinics with which he is associated show no demonstrable cause for their condition and boldly expresses the firm opinion, based on his clinical judgment, that some of these are undoubtedly childless because they are afraid

If it is assumed that emotional disturbances can possibly find their expression in some form of functional abnormality which renders the fruitful meeting of ovum and spermatozoon unlikely, a more satisfying explanation of a number of somewhat puzzling observations can be reached For example, Sydenham (1946) records that 53 67 per cent of the 655 women between the ages of 15 and 45 interned by the Japanese in Hong Kong in 1942 suffered from amenorrhoea of more than three months' duration and dating from the time of the capitulation She does not doubt that the initial cause was emotional shock An intriguing question at once presents itself Is such amenorrhoea associated with non-ovulation? The temperature test for ovulation applied to a series of cases of amenorrhoea caused by emotional disturbance might, as is suggested by the experience of Tomkins (1946), yield information, of great value Bearing on this question also is the authentic account of the reproductive history of the Dutch women in 1944-45, the starvation year in the Netherlands Clement Smith (1947) reports that during that year the conception rate underwent a sharp fall, that half the female population suffered from amenorrhoea, and that 50 per cent of the other half menstruated very irregularly He quite reasonably presents the view that the cause was malnutrition It is of interest to note, however, that the stillbirth rate, the neonatal mortality rate among infants born in hospital and the ability to breast-feed were not significantly affected At this time Holland was an occupied country, the very atmosphere of which was rank with hatred and fear With the rising tempo of the war the hope of liberation, long deferred seemed almost within reach so that tortured hope battled with black despair Surely if psychological factors can affect ovulation, the passage of the ovum onwards toward the uterus, conception, or implantation their effects would be revealed under such circumstances And if it be granted that psychological factors can so affect the female it becomes possible to accept the psychiatrist's teaching that the same factors may be related causally to many of the

varieties of abnormality of the male contribution to conception

At present it would seem that general medical therapeusis can repair infertility in about one-third of the cases that present themselves for advice and treatment It is to be expected that developments in reproductive physiology and gynaecology will soon yield added power to repair much of the infertility that is based upon developmental imperfection and to prevent much of the infertility that derives from obstetrical mischance or mismanagement But if, as seems probable, much of the existing infertility is the expression of the action of psychological factors yielding fear or profound anxiety, the therapy demanded must be of quite another kind and must concern itself with the education of the citizen and with the cultivation of new aspirations and new loyalties Moreover, it will become urgently necessary to enquire whether or not this impaired fertility is a phenomenon that is commonly associated with, caused by, the disharmonies which manifestly exist between the biological nature and needs of mankind and the peculiar social organizations and economic systems that civilized man has evolved, whether it is in large measure a reaction on the part of individuals and groups to conditions and circumstances in the external world that are not conducive to the maintenance of reproductive efficiency

Genes as Limiting Factors

In forms other than man it is firmly established that fecundity rests, partly at least, on a genetic basis—there are "fertility" genes Studies of human pedigrees yield evidence of a sort which suggests that this is also the case in the human subject (see Penrose, 1936, Gates, 1946, for example)

Reproduction implies much more than the production of a newborn child This child must live to reproduce in its turn There are genes that slay the individuals possessing them before the reproductive phase of life is reached or finished The genes which are the causes of Morquio's osseous dystrophy, xeroderma pigmentosum, epidermolysis bullosa, brachyphalangy, telangiectasis, thalassemia, haemophilia, acholuric jaundice, Cooley's anaemia, Werdnig-Hoffman's progressive spinal muscular atrophy of infants, subcortical encephalopathy of Globus and Strauss, encephalitis periaxialis diffusa, Tay-Sachs' amaurotic idiocy, and glioma retinae are examples of these By their action they tend to limit the size of a sibship Thus haemophilia, caused by a sex-linked recessive gene, extinguishes the life of the homozygous female *in utero* and greatly shortens the postnatal life of the affected male He rarely reaches the age of twenty-five, and the few who do and marry have but scant time to reproduce On the average, haemophiliacs produce only about a quarter as many children as do normals It is established (see Cappell, 1946, Race, 1948, for example) that in erythroblastosis foetalis, another disease genetically determined, the production of the maternal antibodies in response to the foetal antigens is so slow and gradual that whilst the earlier members of a sibship remain unaffected the later ones are destroyed (in the absence of appropriate therapy) Mongolism is a disease the causation of which is the interaction of the peculiar genotype of the foetus and certain peculiar conditions of its environment, the maternal organism It is a disease which is generally exhibited by the later members of sibships and, though not in itself lethal, so handicaps its exhibitors that reproduction is impossible and life expectancy greatly reduced

The existence of these genes is clearly demonstrated in the records of stillbirth and infant and child morbidity and mortality From what is known concerning the prevalence and action of similar lethal and sub-lethal genes that operate during the earlier stages of embryonic life in experimental animals and plants it is safe to postulate that in man also such genes are responsible for much embryonic and early foetal death and thus for much abortion and apparent infertility For example, Waterhouse and Hogben (1947) have offered convincing evidence that A—B—O isoimmunization is responsible for the loss of about 25 per cent of the A children expected from marriages A × O, or about 3 per cent of all conceptions The action of such genes is evidenced in the non-appearance or numerical deficiency of certain expected phenotypes in sibships in pedigrees in which the abnormality figures, such non-appearance or deficiency yielding a disturbed secondary sex-ratio when a differential sex lethality is involved, as is frequently the case

The Biological Nature of the Human Female as a Limiting Factor

The number of offspring produced at one and the same time by the female of a species must necessarily affect the total number of offspring produced by her during the whole of her life A survey of the different species in their order of zoological classification strongly suggests that between the place of a species in the zoological scale and the number of offspring produced by the female of that species at one and the same time there exists a direct

relationship—the "higher" the species the fewer the offspring This observation, to which there are, of course, many exceptions, has provoked much speculation Spencer (1899), for example, made the reasonable suggestion that between the maintenance needs of the individual's own life (individuation) and the energy requirements of reproduction (genesis) there is a conflict and that the two are *inversely proportional, the long-lived species being* remarkable for the smallness of their litters Wood Jones (1915) presented the argument that offspring can under certain circumstances constitute a definite handicap to their parents, interfering more or less seriously with their usual behaviour patterns Necessarily there must be some connexion between the conditions of the habitat and the behaviour of the parents on the one hand and the reproductive behaviour of the species on the other Only in those in which the pregnant and nursing female is not too greatly disadvantaged by carrying or rearing a large number of offspring are large litters possible, and only in those species in which the parents provide a 'nursery'—a nest, a burrow—in which the young can find shelter and protection are large litters to be encountered Marshall (1922) hazarded the suggestion that the average number of young produced at one time by the female and the average size of the individuals of the species are inversely proportional, the larger the animal the smaller the litter Fisher (1938) introduced the notion of reproductive economy If a species is to flourish, then, assuming that the conditions of the habitat do not change too drastically, what is required of the individuals of one generation is that they shall produce a succeeding generation at least numerically equal to their own The well-being of a species or population can be measured by the movement of the net reproduction rate Population size is maintained when every fecund female in one generation is represented by at least one fecund female in the next

In general there are two ways in which population size can be maintained or increased, one extravagant, the other economical In the first far more than enough offspring are produced, the excess being removed by gross mortality Thousands of ova are made available by each female for fertilization at the same time but by no means all are fertilized In such forms external fertilization is the rule and there is a complete disregard on the part of the parents for their offspring. The newly born young are more or less well equipped for the satisfying of their own immediate biological needs but being unprotected they suffer great loss from mishap and they from the food supply of their own and other species In the second, the number of ova produced at any one time by the female is reduced to the absolute minimum, fertilization is internal so that conception is made certain, and to the immature young, made precious by their very paucity, are given by their own parents great care and protection

It is in the amalgam of all these various hypotheses that the correct explanation of all the different observations is most likely to be found In general the larger and more complicated the creature is, the longer is the period of time demanded for its growth and differentiation The longer this period is, the longer is the phase of immaturity and dependency of offspring upon adults of its own kind The greater and the longer this dependency is, the fewer the offspring that can be given parental care at any one time Parental care of the immature young can best be provided in an extra-corporeal uterus (a micro-environment equipped with facilities for protection and food supply) a nest, burrow, nursery The fewer the offspring born at one time the fewer the ova that need to be shed The fewer the ova, the more certain must fertilization become For the accommodation of one fertilized ovum a non-cornuate uterus suffices, for the reception of many a bicornuate uterus is required (see Wood Jones, 1945) Where many offspring are born at a time to a mammalian female she must offer a number of mammary glands at least equal to the number of offspring When only one is produced one mammary gland is required (but the rule of symmetry operates to yield a pair) In those mammalian forms which are monotocous there is a direct relation between the anatomy, habitat, and habits of the species and the particular pair of mammary glands that is retained

The human female is characteristically monotocous and her anatomy is in accord with her reproductive habits She extrudes as a rule only one ovum at each ovulation during the period puberty menopause Exceptionally she reveals her phylogenetic relationship by shedding more than one ovum (polyovular multiples) or, like the armadillo, produces an ovum which after fertilization divides to give rise to several embryos (monovular multiples) Fertilization is internal and conception certain if intercourse occurs shortly before or after ovulation (and there are no pathological barriers) Her uterus is non-cornuate, suitable for the accommodation of a singleton She has but one pair of mammary glands, but unlike the marsupial which often produces young in numbers greater than the number of her teats so that some must necessarily die the human female can attach the surplus to a bottle The human young is so immature at birth

and demands so long a period of time to achieve self-sufficiency (and for initiation into society) that in man parental care reaches its highest degree of expression So it is that in man the family grouping reaches its maximum development and in a human society social agencies share, reinforce, and extend parental responsibilities by means of creches, nurseries, schools, universities and the like, and by the provision of foster parents nurses, teachers, policemen, and others By these and similar means any conflict between individuation and genesis can be resolved and the reproductive habits of our species are no longer necessarily limited by the circumstances of our external world, since these latter can be changed by man

Parental care reinforced by communal care does much to reduce mortality among the young The application of science by means of sanitary laws and habits, raised standards of living and of education, advances in medical knowledge, have played their parts in reducing infant and child mortality and in extending life expectancy Since such reduction has outpaced the fall in the birthrate it is eminently possible for a population such as our own to maintain or even enlarge its total size with comparative ease if it so desires Monotocia suffices

The Hazards of Polytocia as Limiting Factors

It would seem to be generally agreed that not more than 20 to 50 per cent of all the twins that are conceived are alive at the end of the period of pregnancy Twins are commonly reduced by foetal death to a singleton, triplets to twins or a singleton The observed facts concerning stillbirth, infant mortality, and maternal mortality in relation to multiple births support the view that the human female is not equipped for the production of more than one young at a time

Stillbirth is several times as common among twins as among singletons Munnell and Taylor (1946) found that the gross foetal mortality (28 1 per cent) among multiples was four times greater than the gross foetal mortality rate (7 0 per cent) for all deliveries, and that the corrected foetal mortality for twins (9 1 per cent) was almost twice as great as the ten-years' average for all deliveries (5 5 per cent) According to Hirst (1940) stillbirths are five times as common among multiples as among singletons Burns' (1942) figures show that it was two to three times as common The figures for Scotland for 1945 were 68 per 1,000 for twins and 33 per 1,000 for singletons

Authorities are agreed that dystocia and birth injury are far more common among multiples for the reason that their mutual interference during parturition tends to lead to faulty presentation As a result of birth injury mental defect has a higher incidence among multiples than among singletons

Prematurity is commoner among twins than among singletons and is universal among triplets and higher Kerr and others (1944) state that premature labour occurs in about 70 per cent of all cases of multiple births It is the outstanding cause of the greatly increased mortality among them Baird (1945) records that multiple pregnancy was associated with 12 2 per cent of premature births, whilst Crosse (1945) puts the figure as high as 16 6 Neonatal death is twice as common among multiples as among singletons, as would be expected since so many of the causes of stillbirth continue to operate during the neonatal period The toxaemias of pregnancy, polyhydramnios, uterine inertia, prolapse of the cord, and post-partum haemorrhage are all much more frequently encountered in multiple pregnancy (see Munnell and Taylor, 1946) Hirst (1940) states that neonatal deaths are five times as frequent among multiples as among singletons Burns (1942) found that the neonatal rate for multiples was about six times that for the whole group, including both multiples and singletons, studied The postnatal rate for multiples in Burns' (1942) survey was twice that of the total population at risk

Maternal mortality is higher in multiple pregnancy Hirst (1940) found it to be, as also did Burns (1942), twice that of singleton pregnancies on account of the greater incidence of haemorrhage and toxaemias

So far medicine has not gained the power to overcome these hazards of polytocia

The Rate of Reproduction as a Limiting Factor

After the first pregnancy the rate of reproduction would seem to have a direct influence upon maternal and infant mortality and stillbirth The advocacy of "spacing" on the part of family planning clinics would seem to be more than justified The state of health of the mother influences in a general way the state of health of the unborn child Child-bearing, and especially long-continued lactation, is a strain from the effects of which the mother recovers, though perhaps never completely in a great number of instances, in time Exposure to the same strain before recovery increases the hazards of pregnancy for both mother and infant Such mothers commonly produce weakly babies among whom the neonatal death rate is high (Burns, 1942) Birth intervals of less than two years predispose to prematurity (Joint Committee, 1948)

THE HAZARDS OF PARITY AS LIMITING FACTORS

Stillbirth, infant mortality, and maternal mortality are all related to parity It would seem that either the strain of reproduction is cumulative or else the reproductive efficiency of the human female deteriorates with an astonishing rapidity It is to be stressed, however, that it is not always a simple matter to disentangle the effects of maternal age and of socio-economic circumstance from those of parity itself

The probability of a stillbirth is least in the case of a second pregnancy and thereafter rises with increasing parity The probability of a stillbirth in the case of a first child is greater than in the case of a fourth but less than in the case of a fifth The stillbirth rate is higher at all ages of the mother for primiparae than for multiparae of the same age, the rates for both increasing after the age of 25 (Sutherland, 1946), and of the two factors, parity and maternal age, the former would appear to be the more important

Prematurity is least among mothers aged 25 to 35 First babies are more often premature (8 0 per cent) than those resulting from subsequent births (5 3 per cent) For all birth orders premature births are more frequent among the poor, the cause for this being multiple maternal age, parity, inadequacy of antenatal care, nutrition (Joint Committee, 1948)

Neonatal mortality, like stillbirth, decreases with increasing parity up to a point for the reason that first births carry an extra risk But Burns (1942) found that among seventh and later children neonatal deaths (including stillbirths) were greater than the total deaths (including stillbirths) up to the age of five in the case of the first, second, and third children, and presents the view that this early death among later sibs would not be seriously affected by any system of family allowances or such like

Postnatal mortality cannot so easily be related directly to parity It increases with family size for the reason that large families involve an extra risk of infection of the most recent addition by its older sibs In this country, too, there is a direct relation between family size and the socio-economic circumstances of the home larger families are found for the most part among the poorer strata in which the women seem incapable of planning their lives (*Lancet*, 1945) Thus it is that large family size is so commonly associated with low income, thriftlessness, poor educational standards, low standards of living insanitation in the home, and avoidance on the part of the mother of the clinics which offer help in the matter of contraception and maternal and child welfare No wonder, then that Yudkin (1944) found that children from small families were bigger and heavier and had a higher haemoglobin level than children from large families and that these differences were greater in the case of children from the poorer areas, or that Burns (1942) found in her classical survey of infant and child mortality in Durham that families with the lowest death rate were the one-child families, and that the late children of large families had a high death rate at all stages Bearing on this question also are the observations and tentative conclusions of Fraser Roberts (1939), Burt (1946), Thomson (1947), and Himmelweit (1948), which suggest that there is a negative correlation between intelligence and size of family These most important and disturbing conclusions have been subjected to criticism by Woolf (1947) and await final proof

There is a gradual increase in maternal mortality with increasing age of mother, the rate becoming sharply accelerated after the age 30 to 34 Furthermore, when marriage or the first pregnancy is postponed to an age around 30 then, as Burns (1942) has shown, not only is the first birth relatively dangerous but all subsequent births are associated with a maternal death rate which is relatively high for that stage of the family This in part explains the lack of improvement in maternal mortality in the better-off classes who, on the whole, marry late. It is exceedingly difficult to separate the effects of maternal age and parity It can safely be said, however, that if all families consisted of three or four children born to mothers under 30 the maternal mortality rate would be halved Primiparae have a higher death rate than 2-, 3- and 4-parae Mortality is lowest in 2-parae and is under average in 1-, 3-, and 4-parae In more than 4-parae it is in excess, this excess increasing steadily with each additional pregnancy (see Report of Scottish Departmental Committee, 1944)

Although the production of large families is associated with a high maternal mortality the decrease in the average size of family has not been attended by a corresponding fall in the maternal mortality rate, for the reason that a decrease in average family size means an increase in the proportion of first births, these being associated with increased hazards, and that first births now occur more frequently at older maternal ages than used to be the case so that greater risks must be encountered Moreover, when the first birth is postponed all subsequent births must occur at ages which are associated with maternal risks relatively high for the birth rank of the child

It is exceedingly difficult, if not impossible, to advocate early marriage and early childbearing on purely biological grounds Now that life expectancy

has become so greatly extended it is but reasonable to spend more time in apprenticeship This is the real argument in favour of the raising of the school leaving age If the average woman at birth can expect to live to 60 she can afford to spend her first 25 years in equipping herself with the skills and the arts of living Marriage is a social institution and those who engage in this contract can reasonably be expected to be socially as well as biologically mature

There can be no doubt that if the present social gradient in respect of stillbirth, infant mortality, and maternal mortality could be obliterated by adequate social action these rates would greatly fall At the present time the poorer among us tend to marry and reproduce earlier than do the relatively well-to-do There is thus an association of early reproduction and poor environmental circumstances on the one hand and later reproduction and good environmental circumstances on the other The present distinction between the socio-economic classes in respect of infant and maternal mortality suggests that in so far as these hazards are concerned environmental circumstance is more important than parity and maternal age (within limits) But even though the obliteration of this gradient would undoubtedly yield an equalization, and the stillbirth rate and the infant and maternal mortality rates generally would then be those which now are characteristic of Class I of the Registrar-General, it is quite certain that the effects of parity and of maternal age would still be easily discernible

Two notions emerge from a consideration of these observations The first is that since the first pregnancy is so much more hazardous than the second (the least hazardous of all) for both mother and child it would seem that in the human subject, as in the laboratory animal (see Asdell, Bogart, and Sperling, 1941), pregnancy has a maturing effect which yields a greater efficiency in reproduction If this is so, then investigation should be planned to discover a method whereby the O-para could be prepared for pregnancy (endocrinological or nutritional priming, application of physical medicine ?) so that the first pregnancy could, as it were, become the second If this were possible much life could be saved Another matter that deserves investigation is that of reducing to a minimum the drain of lactation upon the mother and at the same time safeguarding the interests of her infant Maternal age is, of course, a complicating factor The potential reproductive efficiency of the human female is at its peak in the woman under 25, appearing to begin to decline after the age of 20 or so The observation of Matthews Duncan (1866) that the initial fecundity of women gradually waxes to a climax, probably about the age of 25, and then gradually wanes still commands the support of the great majority of obstetricians and is in line with the evidence derived from animal experimentation It follows, therefore, that what is required is the maintenance of youthfulness of the individual as a whole and the maturation of her reproductive system

The second notion, due allowance having been made for the effects of maternal age and unpropitious environmental circumstance, is that the human female is not built for the efficient production of more than four children in all, or, as Kerr and others remark (1944) "These facts might very naturally be advanced as an argument in favour of limitation of conception after the fourth or fifth pregnancy" In connexion with this second notion it is of peculiar interest to find that there is a very widespread lay opinion that the optimum family size is three to four The British Institute of Public Opinion recently issued the figures given in the table (*News Chronicle*, May 30, 1948), whilst Baird

TABLE

BRITISH INSTITUTE OF PUBLIC OPINION SURVEY OF PREFERENCES IN FAMILY SIZE
(From the *News Chronicle*, May 30, 1948)

Number of children thought best	Great Britain %	France %	Canada %	Australia %	Holland %
1	4	5	1	1	1
2	39	31	21	14	22
3	27	38	22	21	29
4	20	17	28	46	24
4+	4	5	26	16	22
No opinion	6	4	2	2	2
	100	100	100	100	100

(1946) found on enquiry that most of the poorer mothers with ten children, as also most of the well-to-do with one or two, admitted that they would have been happier with three or four These expressions of opinion can surely be accepted as being representative of the peoples of present-day communities with a social structure and philosophy more or less similar to our own and with adherents to the different churches present in the population in the same kind of proportions They are supported by the observations of Titmuss and Grundy (1946) to the effect that in Luton there had occurred during a period of three generations a large increase in the proportion of one- and two-child families and a dramatic fall in the proportion of families of five or more

The Bearing of these Observations and Suggestions upon Population Policy

The industrial revolution can rightly be blamed for much human misery and for much misdirection in our development as a society Nevertheless, it is to this industrialization and urbanization and to the reactions of human beings to the circumstances so created that indirectly a significant reduction in family size must be ascribed Economy in children made it possible for families to survive and to share in the abundant material wealth that was then created and thus in the rising standards of living It is to be noted that this reduction in family size was not followed by a reduction in population size In fact the population increased at an unprecedented rate, for the reason that though fewer children were being produced far fewer died than was formerly the case In this decline in mortality the reduction in the average size of the family was by no means the least important factor, for between the size of the family and the chances of survival on the part of the members thereof there was and still is a direct relationship It is established that large average family size is not a prerequisite for population maintenance or increase

In a recent P E P publication (1948) it is stated that " the objective to be achieved (by a population policy) is stable fertility at a level involving an average number of about 2·5 children in each family, and this average will mean a considerable number of families of four or five children ' This statement, which will command the support of almost everybody and every organization that is concerned with the maintenance of our population size, is in remarkable accord with the facts and opinions presented above If it is true that there is a strong biological urge toward parenthood in most individuals, then this urge in the great majority of instances is satisfied with a family of two, three, or four The individuals in the opinion survey cited were relating family size to their own circumstances and were not interested in demographic considerations Yet their opinions concerning the optimum size of their own families coincide exactly with the conclusions reached by scientists in their calculations concerning population growth and with the observed facts relating to the connexion between mortality and family size Manifestly if the average family size is to be 2 5 and the maximum 4, then in the absence of families of 4 + there will have to be far more families of 3 and 4 How many more it is difficult to determine using such figures concerning family size as are available, but if the Scottish figures are taken and if the present distribution of family size in the population is accepted as the basis for argument and if illegitimacy is disregarded, then it would appear that certainly not less than *about 50 per cent of the parents with no, one, two,* and three children would be required to produce an additional child The ideal policy would seem to be the encouragement of the majority of parents to produce a family of three whilst the mother is still young, and in the case of the families of proven biological worthiness, as estimated by the low incidence of stillbirth, infant and maternal mortality and morbidity, to encourage the production of additional offspring Should this ever become the objective, then the impaired fertility of the childless and small family couples desiring children or more children would become a problem of even greater importance (In the rat (see Asdell and others) the productive ability of the female throughout life is indicated by her initial performance This is probably true also in the case of the human female but the yardsticks by which performance is measured must be different)

Summary

1 The phenomena of childlessness and small family size are common and are important limiting factors The part played by psychological factors in the causation of low fecundity is considered

2 Lethal and sub-lethal genes play their part, a by no means unimportant one

3 It is argued that the human female is characteristically monotocous and shown that polytocia greatly augments the hazards of childbearing and that monotocia suffices for the maintenance or increase of population size

4 It is shown that the rate of reproduction, parity, and maternal age all operate to limit family

size—a rapid rate, increasing parity, and increasing age all being attended by increasing infant and maternal mortality

5 Since the first pregnancy is peculiarly hazardous and the second the least so, it is suggested that investigations should be undertaken to discover the means whereby the first could be ridded of its dangers, could be, as it were, transformed into the second

6. Evidence is displayed which points to the conclusion that the maximum family size should be four for the majority of married couples

7 The evidence derived from opinion surveys shows that the " best " size of family is three to four

8 Demographers are agreed that for the maintenance of our population size the average size of a family should be 2 5, which means that many must produce three, four, and five

9 All things considered it would seem that the majority of married couples should be encouraged to produce three children whilst the mother is still young, and that those who together with their early offspring display an extraordinary healthiness should be encouraged to produce additional children If families of more than four are not to be encouraged then it would appear that not less than 50 per cent of parents with one, two, or three children would have to produce an additional child if the total population size is to be maintained

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STUDIES OF THE DIET OF STUDENTS AT EDINBURGH UNIVERSITY

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INTRODUCTION

Sir John Boyd Orr (1937) demonstrated that in the social and economic conditions prevailing in Great Britain during the nineteen-thirties one-tenth of the population was consuming food which was both insufficient in quantity and unsatisfactory in quality when compared with accepted dietary standards This underfeeding was associated with much ill health and poor physical development The outbreak of the 1939-45 war stimulated the Government into a large number of measures designed to control the distribution of food equitably and thereby to raise the level of health and the martial efficiency of the people In this the Government appeared to achieve a great success, and the consensus of public opinion was that the limited food resources available throughout the period of the war were shared out equitably in relation to human needs Further, the majority of expert opinion agreed that not only had the general health of the people not deteriorated as a result of the food restrictions, but in certain respects notably as regards infant and maternal health, an improvement had taken place Rationing, with its inconveniences and irksome restrictions, was accepted as inevitable while hostilities lasted Many persons had however, fostered the false hope that, with the cessation of fighting in 1945, food restrictions too would soon cease But few people had realized the precarious position of international agriculture even before the outbreak of hostilities, and the serious blows it received during the war The damage to world trading also precluded any possibilities of an immediate, plenteous supply of food capable of meeting all demands Indeed, in 1946-47 and in early 1948 the food situation in this country deteriorated A "dollar crisis" in the autumn of 1947 and a partial failure of our potato crop combined to make that winter perhaps the worst from a food point of view since 1939 It has now indeed become clear to almost all of us that food shortages are likely to persist for a long period and that restrictions are a feature of peace as well as of war

Now, rationing is no longer a military emergency measure and a complex governmental food-controlling machine has become a recognized part of peacetime economy It is therefore important to devise means to study the machinery and its effect on food consumption and food habits Experiences of other countries have shown that a rationing scheme may be one thing on paper and a very different affair in practice The present survey was undertaken to find out how a group of people were in fact faring during the winter 1947-48 University undergraduates enjoyed no special privileges as regards food All the special rations for schoolchildren cease at the eighteenth birthday, before most of the students have entered the University and also before many of the men have completed their growth and reached full stature Further, university students who live at home or in lodgings do not receive the benefits of the numerous industrial canteens available throughout the country to so many young people The study, then, is of a group of people with no special privileged source of food supply

SCOPE OF THE SURVEY

In all 298 students took part in the survey and had their food consumption recorded Only those students under 21 years were selected With one or two exceptions none of them had undertaken

military service Thus the special problems presented by the large numbers of ex-service students were deliberately avoided and the sample selected as representative of young persons coming to the University straight from school Table I shows the numbers of each and of their residence during term

TABLE I—

NUMBER OF STUDENTS SURVEYED

		Men	Women	Total
Living	at home	61	71	132
	in lodgings	47	74	121
	in University hostels	19	26	45
	Total	127	171	298

Of this total, 145 were from the Arts faculty, 113 from Medicine, and 40 from Science The Law and Divinity faculties contain only graduates proceeding to secondary degrees, so they were not included No essential difference was found between the diets of the students in the different faculties, and no analyses on this basis have been recorded

For the survey of students living at home or in lodgings, names were selected at random from matriculation rolls in the faculties of Arts and Medicine, and each selected individual was written to and asked to co-operate Out of 126 selected medical students, 98 (78 per cent) accepted and completed the survey In Arts, 250 students were written to and 127 (51 per cent) completed the survey The numbers of those willing to take part in the survey were actually higher than these figures indicate Unavoidable absenteeism prevented several students from co-operating The 28 science students were all volunteers The number of students in this faculty below the age of 21 was too small to allow any selection The hostels chosen for this investigation were the two largest hostels for men and women respectively attached to the University In the men's hostel there were 100 students studying in all faculties of the University On account of war service, many were older than usual, but 25 were below 21 years of age and of these, 19 completed the survey satisfactorily The women students were chosen from a group of five hostels with common catering arrangements on the outskirts of Edinburgh, each with some 60 students From these the names of 30 girls below 21 years were selected at random These girls were asked to participate, and 26 concluded the survey

The recordings took place at the end of the autumn and the beginning of the spring term, and covered the months of December, January, and February only Each student was under continuous observation for eight consecutive days during this period

TECHNIQUE

Many observers have produced reliable methods for the measurement of the food consumption of a whole family in the home Weighing of all available food in the kitchen is the basis of these methods Details of technique vary according to the socio-economic level of the home, but accurate records of family food consumption in the home have been made in many countries throughout the world and in widely different social classes Family surveys, based on observations in the kitchen, fail to record accurately the food derived from restaurants and canteens—a large and increasing proportion of the total food consumption in Great Britain today Such surveys also can give no account of the distribution of the food within the family To get accurate information on these points, nutrition workers have been developing methods of individual survey

The accurate recording of the daily food intake of an individual is an exceedingly difficult task The pioneers in this work were the classical experimental physiologists of the end of the nineteenth and beginning of the twentieth century For the metabolic measurements which they were making, precise records of food consumption were required, and for the most part "professional" subjects were used for the experiments The difficulties of obtaining accurate dietary records are numerous and put a great strain on the honesty and good faith of the subject Benedict (1919), a most experienced observer, preferred to choose the students of a religious foundation as his experimental subjects Yet he asked them to promise in writing faithfully to weigh all they ate and took great pains in addition to obtain confessions of any items which they accidentally failed to record

More recently, individual diet surveys have been made of larger groups in which each individual has been asked to weigh and measure every article of food immediately before consumption Widdowson has been a pioneer in the use of this technique and records surveys of 63 middle-class men (Widdowson, and McCance, 1936), of 63 women, again nearly all from the middle class (Widdowson, 1936), and of 1,028 children (Widdowson, 1947) These and similar surveys have provided much valuable basic physiological knowledge For sociologists and food

administrators the technique has two limitations First, only subjects who are willing, co-operative, and intelligent can be surveyed Secondly, it is impossible to assess the changes in normal food habits and customs that may be brought about by the necessity of weighing all food before eating The individual weighed survey may indeed give an accurate record of food consumption during the period of the survey, but this is not necessarily an accurate record of normal food consumption

In an attempt to make the method more generally applicable with a minimum of loss of accuracy, some observers, notably Youmans and others (1942) and Bransby and Wagner (1945) have used ordinary domestic measures, such as cupfuls, spoonfuls, etc, instead of balances Cups and spoons of a uniform size are provided, and sometimes models of foods with which the actual amounts eaten are compared Bransby and others (1948) have shown that under certain circumstances these "homely measures" can be substituted for balances without any substantial loss of accuracy

Some information about the nature and adequacy of a diet can be obtained by the collection of a simple diet history This is essentially the method of practical clinical medicine History-taking is a difficult art and suffers from the drawback that all data obtained are subjective in origin Yet such data, if lacking the special precision of chemical measurements, may yet serve as useful guides to human behaviour The "questionnaire" type of survey has the outstanding advantage that it involves a minimum of interference with the normal life of the subject It can be used much more widely amongst the people than the weighed individual survey and, further, it is less likely to alter the usual dietary pattern We have used this questionnaire method as being the only method, in our opinion, available for a survey of the extent we wanted We have, however, added a number of safeguards in an attempt to get the recording as accurate as possible The method which we employed was as follows

After the subjects had been selected and had agreed to co-operate, each was interviewed At the interview the object of the survey was explained and each person was given a log-book in which he was asked to record in spoonfuls, cupfuls, number of slices, etc, the quantities of every item of food eaten It was stressed that records should be made as soon as possible after each meal An appointment was made for the following day At this, a dietitian went over the log-book and assessed the exact quantity of each article of food In order to help in determining the weight of each item, a selection of nearly two hundred portions of common foods ready for consumption was displayed on a table For example slices of bread of varying thicknesses and from loaves of different shapes, different types of sausages, thick and thin portions of cooked meats, fish, etc, various kinds of both cooked and uncooked vegetables, samples of the fresh fruits available at the time, stewed fruits, and a wide variety of cakes, buns, scones and biscuits, portions of butter, jams, etc, were all included in this display The foods were displayed as for serving and the actual weight of each sample, when first prepared, was recorded Formalin was used to preserve some of the meats, but many samples had to be replaced frequently to avoid shrinkage and desiccation Every attempt was made to include all items in this display and if a student had consumed something not on display, it was obtained for the following day A number of subjects brought from home duplicate samples of less familiar foods, if he or she found the quantity difficult to describe to the dietitian In addition four different portions of each type of food served in the men's and women's Unions, where many of the students had their mid-day meals, were weighed Buns, cakes, etc, as served at the snack counters, were weighed, and similarly cakes and buns from the popular restaurant in the vicinity of the University

The students recorded their food consumption for eight consecutive days The first day's record was considered as a trial and discarded An attempt was made to fix interviews with the dietitians every day during the week except Sunday This was not always possible, but each student had at least five interviews and many had more All the dietitians employed had had considerable experience of survey work, and this was very valuable in enabling them to assist the students clearly to identify the foods they recorded in their log-books and to make quantitative comparisons with the weighed foods

Finally, the great majority of the students had an interview with the whole investigating team three or four months after the recording had finished At this interview the records had been added up and analysed and the results shown to each student It was possible to discuss any apparent anomalies and to discard a few surveys (less than 2 per cent) in which the recording had been obviously incomplete, or in which, owing to illness or other circumstances the diet for the week had clearly been different from the usual pattern At this interview much information was obtained about the student's personal attitude to food, his or her likes and dislikes, and how each reacted to food restrictions and rationing.

It is extremely difficult to assess the accuracy of

the questionnaire method The only check that we have been able to carry out has been a small comparison with the weighing technique Students who were living at home and seldom ate out were asked if they were willing to repeat the recording for a further seven days in exactly the same fashion, but on the second occasion actually weighing and recording each item of food before consumption

Only eight volunteered to undertake a weighed survey and this, in itself, is an example of the difficulties and limitations of the weighing technique Table II shows the average daily nutrient intake of these eight subjects according to the two methods of assay

TABLE II

AVERAGE DAILY INTAKE OF CALORIES AND NUTRIENTS FOUND IN EIGHT SUBJECTS BY TWO DIFFERENT SURVEY METHODS DURING TWO CONSECUTIVE PERIODS OF SEVEN DAYS

	Weighing	Questionnaire
Calories	2,660	2,710
Protein (g)	90	94
Fat (g)	94	105
Calcium (g)	1 0	1 0
Iron (mg)	18	19
Vitamin A (I U)	4,500	4,300
Vitamin C (mg)	72	65

The check, as far as it goes, confirms Bransby and others (1948) in the general conclusion that the weighing and questioning method can give approximately the same average values for energy and nutrients under certain conditions While this may be so for average values, greater variations occur in individual diets

Individual differences in the average daily calorie consumption were all under three hundred calories Boulton (1945), quoted by Widdowson (1947), found similar variations when she studied the average daily consumption over a period of four consecutive weeks using the weighing method all the time It would, of course, have been ideal to have had both methods in operation during the same week but the method could not be checked by asking the subject to weigh his food and later during the same day describe it at an interview It is, too, of interest to note that in spite of the fact that each subject had gained some experience in recording during the first week, we still found, on all books except one, one or two items insufficiently recorded. Where the weighing technique is being carried out by the subject without any personal contact with the investigator it seems highly probable that a number of adjustments will be necessary before the calculation of the diet in terms of calories, etc, can be carried out

It is clear, on both theoretical and practical grounds, that it is impossible to check accurately any method for carrying out individual diet surveys A diet survey is a complicated sociological process in which conditions cannot be controlled and repeated as in a chemistry laboratory The final test of the value of any survey method is the practical value of the conclusions that can be drawn from it

RESULTS

AVERAGE DAILY CONSUMPTION OF NUTRIENTS — Even a small diet survey means the collection of a vast amount of data The selection of the best method of presentation of the data involves difficulties The most usual method is to convert the quantities of foodstuffs consumed into calories and nutrients Daily consumption of each of these is determined and recorded, sometimes with a range of extreme values and with a calculation of the standard deviation of the values We have followed this practice, and Table III records average daily consumption of calories and nutrients Such a table provides a convenient method for summarizing the results of a survey in chemical terms The preparation, however, necessitating the use of a detailed table of food analyses involves a considerable additional source of error Our results have been calculated from tables in use at the Ministry of Food, which, with certain modifications, are based on *The Nutritive Value of Wartime Foods* (Accessory Food Factors Committee, 1945) and *The Chemical Composition of Foods* (McCance and Widdowson, 1946)

For made-up dishes, it is inevitable that there must be considerable variations in the recipes used for their preparation, each differing from the samples analysed for the preparation of the tables Where the ingredients of an individual dish were known, the analyses were based on this information Bransby and others (1947) have shown that assessments of diets using standard food analysis tables may differ in important respects from an assessment of the same diets obtained by chemical analysis of aliquot samples of food consumed.

Age, height, and weights are recorded in Table IIIA, and the American National Research Council Recommendations for dietary allowances (as revised in 1948) in Table IIIB It is difficult to know with which N R.C class Edinburgh students may be best compared, for the average ages of all our groups was 19 and so they were not strictly comparable with the 16-20 group Average weights for our men

TABLE III

NUTRITIVE VALUE OF DIETARY INTAKE OF VARIOUS GROUPS

		Men			Women		
		At home	In lodgings	Hostels	At home	In lodgings	Hostels
Calories	M	3,040±580	2,900±470	2,960±290	2 180±370	2,280±400	2,330±310
	R	2,140 - 4,690	2,150 - 3,870	2,440 - 3,590	1,450 - 3 160	1,520 - 3,220	1,750 - 3 080
Total protein (g)	M	101±19	102±15	97±11	76±13	78±13	79±12
	R	74 - 163	77 - 137	81 - 109	51 - 118	49 - 102	56 - 99
Animal protein (g)	M	45±11	47±9	39±7	39±10	38±8	38±8
	R	30 - 77	30 - 62	25 - 58	20 - 76	20 - 61	21 - 51
Fat (g)	M	106±23	101±20	92±15	81±16	83±15	89±15
	R	64 - 185	67 - 153	70 - 122	52 - 111	51 - 116	71 - 142
Calcium (g.)	M	1 2±0 3	1 1±0 2	1 2±0 2	0 9±0 2	0 9±0 2	0 8±0 1
	R	0 7 - 1 7	0 6 - 1 7	0 9 - 1 7	0 4 - 1 3	0 5 - 1 3	0 5 - 1 0
Iron (mg)	M	20±4	21±3	22±3	15±3	16±3	18±3
	R	12 - 34	15 - 28	17 - 26	10 - 26	9 - 24	12 - 23
Vitamin A (I U)	M	4,800±2,300	4,800±2,100	6,700±1,800	3,400±1,800	4,300±1,900	5,800±2,400
	R	1,600 - 11,300	1,000 - 9,800	4 900 - 12,300	1,000 - 10,300	1,100 - 11,500	2,500 - 10,900
Vitamin B_1 (mg)	M	1 7±0 4	1 7±0 3	1 7±0 2	1 2±0 2	1 2±0 3	1 2±0 2
	R	1 1 - 2 7	1 0 - 2 2	1 4 - 2 2	0 7 - 2 0	0 7 - 2 2	0 9 - 1 5
Riboflavin (mg)	M	1 7±0 4	1 6±0 3	1 8±0 3	1 3±0 3	1 3±0 2	1 4±0 3
	R	1 1 - 2 7	1 1 - 2 2	1 4 - 2 3	0 8 - 2 2	0 7 - 2 1	0 7 - 1 9
Niacin (mg)	M	14±3	14±3	17±5	10±2	11±3	11±2
	R	10 - 22	8 - 23	12 - 31	6 - 16	6 - 14	7 - 14
Vitamin C (mg)	M	75±45	55±26	60±15	60±30	60±30	50±10
	R	20 - 160	20 - 120	40 - 100	15 - 125	20 - 120	40 - 85

M—Mean ±—Standard deviation R—Range of extreme values

TABLE IIIA

AGE, HEIGHT, AND WEIGHT OF SUBJECTS

No in Group		61	47	19	71	74	26
Age (months)	M	229±10	231±10	240±10	233±10	234±10	242±5
	R	205 - 247	210 - 254	216 - 250	213 - 250	206 - 255	230 - 251
Height (inches)	M	69 5±2 1	68 5±2 1	71 2±1 8	64 5±2 2	64 5±2 2	65 0±1 9
	R	65 0 - 73 0	64 5 - 73 5	66 0 - 74 0	60 0 - 69 5	58 5 - 68 5	61 0 - 69 5
Weight (pounds)	M	146±12	146±15	155±15	131±15	128±16	133±13
	R	114 - 176	125 - 185	133 - 193	102 - 171	94 - 176	111 - 161

M—Mean. ±—Standard deviation R—Range of extreme values.

TABLE IIIB

RECOMMENDED DAILY DIETARY ALLOWANCES, FOOD AND NUTRITION BOARD, NATIONAL RESEARCH COUNCIL

	Calories	Protein (g)	Calcium (g)	Iron (mg)	Vitamin A (I U)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)
Man—156 lb									
Sedentary	2,400	70	1 0	12	5,000	1 2	1 8	12	75
Physically active	3,000	70	1 0	12	5,000	1 5	1 8	15	75
Boy 16-20 years (141 lb)	3,800	100	1 4	15	6,000	1 7	2 5	17	100
Woman—125 lb									
Sedentary	2,000	60	1 0	12	5,000	1 0	1 5	10	70
Moderately active	2,400	60	1 0	12	5,000	1 2	1 5	12	70
Girl 16-20 years (119 lb)	2,400	75	1 0	15	5,000	1 2	1 8	12	80

were almost identical with the N R C figure for an adult man, and for women our average weights were all higher than the N R C figure for an adult woman

Calories—The average consumption of calories by all three groups of men was the same and almost identical with the N R C recommendations for "Physically Active Man" For women, the average for all three groups fell between the N R C figures for "Sedentary" and "Moderately Active Woman" These figures are consistent with the fact that our students could be described as "sedentary" for five days of the week, though many took vigorous athletic and other exercise at the week-ends None of the students complained of an inability to obtain a sufficiency of energy-yielding foods The figures probably reflect accurately the physiological requirements

Protein—The average total protein of all groups of both men and women were well above the N R.C recommendations for adults, and indeed in all cases, almost exactly on the higher levels recommended for adolescents A very few individual women had low recorded intakes, but the study indicates that total protein consumption was satisfactory

Animal Protein and Fat—The N R C gives no recommendations for these nutrients In all groups of men and women, average consumption of animal protein was over 40 per cent of the total protein intake, and the average consumption of fat provided over 30 per cent of the total dietary calorie value The fat consumption in the men's hostel was just below this figure, but this exception cannot alter the conclusion that, in respect of animal protein and fat, all groups had sufficient for physiological needs

Calcium—All three groups of men had average calcium intakes, midway between the N R C recommendations for adults and for adolescents, but all three groups of women were below both standards The higher figure for the men is a reflection of a higher bread intake with the additional calcium therein The N R C recommendations are high, and undoubtedly provide a wide safety margin There can, however, be little doubt that some students, especially the women, with recorded intakes of 0 4 and 0 5 g, were not taking what would be judged sufficient for satisfactory maintenance of bone

Iron—Consumption by men was adequate, and the averages for all groups of women satisfactory However, individual women with recorded iron intakes of only 9 and 10 mg were not obtaining a sufficiency As will be described later, this is consistent with the presence of a mild anaemia in a small minority of the women

Vitamin A—During the survey week, the men's hostel had an extra supply of cheese, and the women's hostel an unusual supply of liver These put up average vitamin A intakes in the hostels Vitamin A activities of the diets varied widely and depended to a great extent on individual consumption of carrot As vitamin A can be stored in large amounts in the liver, low intakes during one week may be partly compensated for by large intakes of vitamin-A-rich foods in another week Thus the very low recorded intakes in one week of some students may not give a true overall picture Only 5 per cent of the students took cod-liver oil or other vitamin A preparations regularly Vitamin A from these sources has not been incorporated in group averages

Vitamin B_1—The average consumption for all groups appeared to be adequate, the quantity present in the diet varying proportionately with the calorie consumption

Riboflavin—The average values obtained were slightly lower than the N R C recommendations,

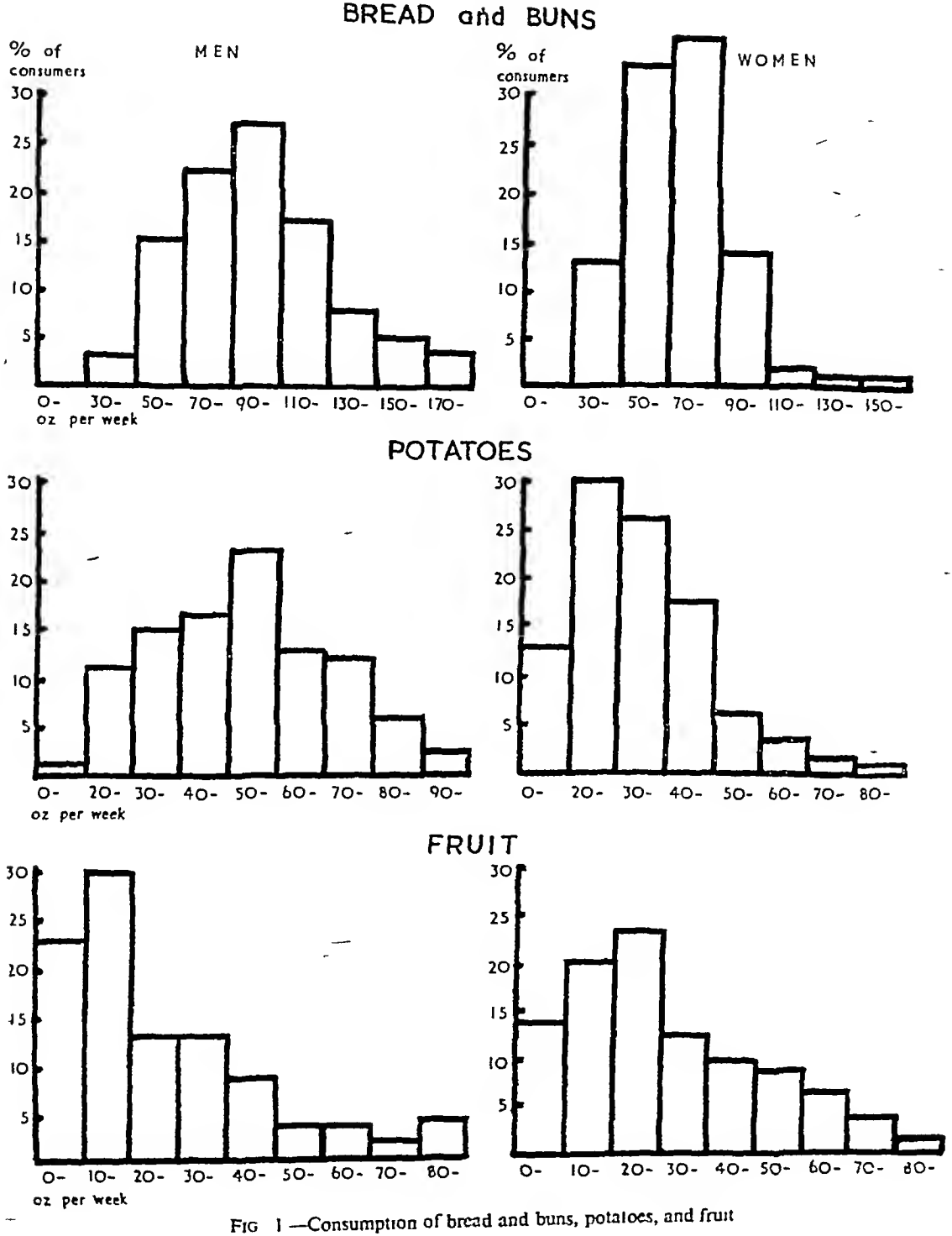

FIG 1 —Consumption of bread and buns, potatoes, and fruit

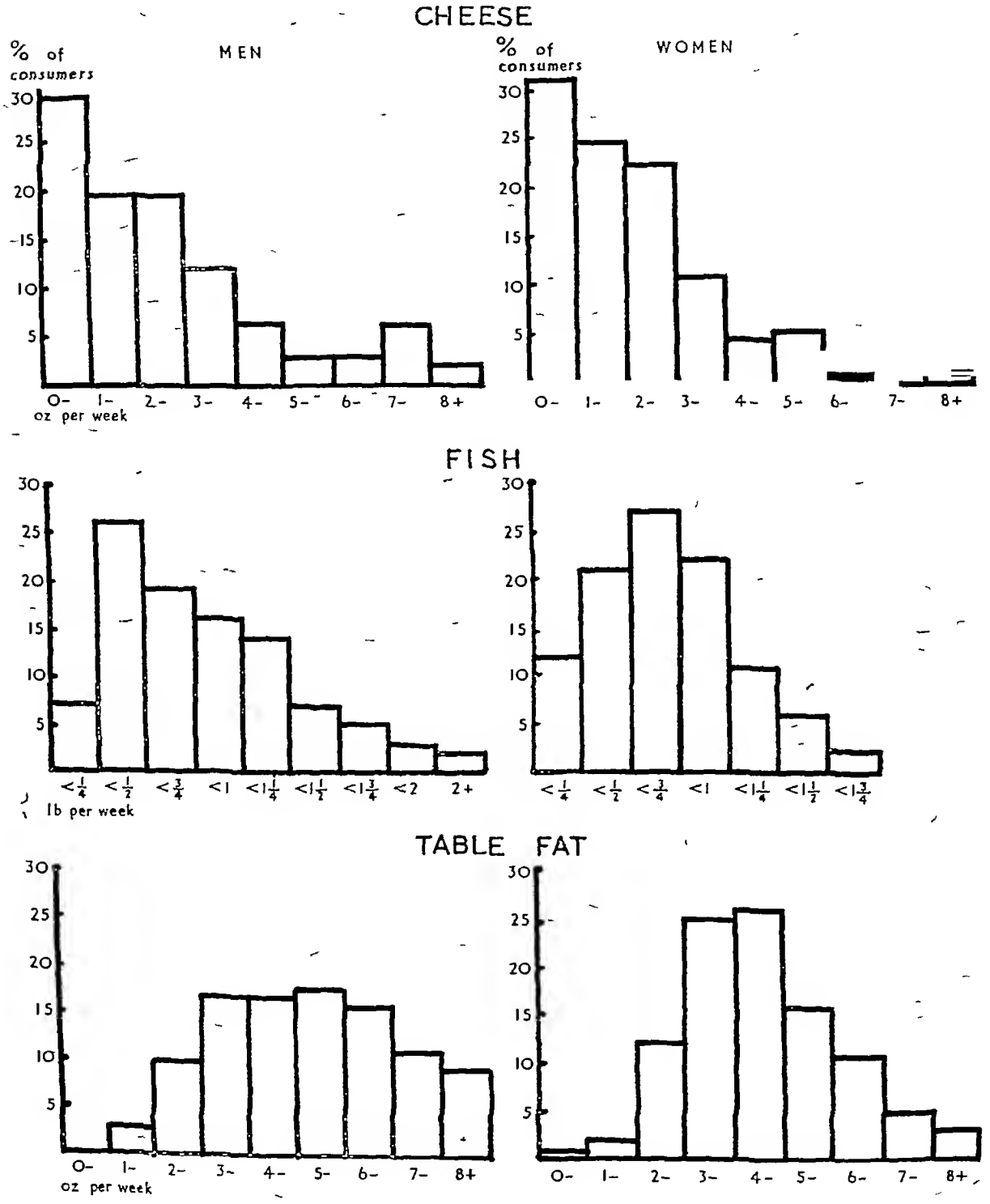

FIG 2—Consumption of cheese, fish, and table fats

the hostel groups being higher because of the inclusion of liver and cheese

Nicotinic Acid—As for riboflavin, the average values were approximately that suggested, but again the range was very wide Only five subjects supplemented their diet by the addition of vitamin B complex from proprietary brands of foods or from synthetic sources

Vitamin C—Average vitamin C intake for the groups was satisfactory, but individual consumption varied widely The low figures recorded in many individual surveys are a measure of the low consumption of fruit and vegetables, discussed in the next section The table of analyses used gave values for cooked vegetables, and no consideration of losses in storage on hot plates was made Some losses undoubtedly arise in this manner, and the average figures given are therefore probably a little high

CONSUMPTION OF INDIVIDUALS FOODSTUFFS—An *alternative method of presentation is to record* consumption of separate foodstuffs In the tables which follow, this has been done Instead of calculating a mean value for consumption and giving ranges, we have expressed the results as the number of persons under survey consuming a given quantity of food In this way it is possible to show clearly the wide individual variations and also to relate these variations to the standard ration scales in force at the time, which were of necessity arbitrarily fixed

The data which follow apply only to the 253 students living in lodgings or at home The 44 students in hostels have not been included, since their diet was relatively standardized The summary of the chemical analysis (Table III) shows that on the whole these hostel diets were satisfactory

Cereals—Table IV records the quantities of cereal in ounces per week consumed in the form of bread cakes, buns scones, etc It does not include the relatively small amounts of cereal taken in the form of pudding macaroni porridge, or breakfast cereal Wide differences in consumption occurred in both sexes but none were found between those living at home and those in lodgings No student said that he was unable to get enough bread all said that they could eat as much of it as they desired The official bread ration at the time for an adult was 63 oz per week There were clearly supplies to meet the demands of those who required more

The eating of large quantities of cakes and buns is a characteristic of nearly all Edinburgh students Most of the men and women took more than one-third of their total cereal as cakes or buns and often the proportion was over half Women were found to eat slightly more buns than men

TABLE IV

RECORDED CONSUMPTION OF CEREALS

Ounces of bread, cakes and buns per week	Number of students	
	Men	Women
30-49	3	19
50-69	16	48
70-89	24	52
90-109	29	21
110-129	18	3
130-149	9	1
150-169	5	1
170+	4	0

The assessment of the amount of cereals consumed as puddings is difficult, as recipes vary greatly The puddings most commonly taken were steamed puddings, tarts of various kinds, custard and semolina, though many more were met with occasionally In about two-thirds of the diets of both men and women the weekly intake lay between 10 and 30 oz The number of times per week that puddings were consumed is shown in Table V Again, no difference was found between those at home and those in lodgings

TABLE V

CONSUMPTION OF PUDDINGS

Number of times per week	Number of students	
	Men	Women
0	0	5
1	10	3
2	11	7
3	16	22
4	28	51
5	26	29
6 and over	17	28

Porridge no longer plays a predominant role in the diet of the Scottish student Although it is frequently taken at breakfast, only one man ate it regularly at other times of the day Table VI shows the frequency with which porridge was taken at breakfast

There is a marked sex difference here Whereas the majority of men had porridge for breakfast most days of the week most women never touched it

TABLE VI

CONSUMPTION OF PORRIDGE

Number of times per week	Number of students	
	Men	Women
Never	27	84
Occasionally (1-3 times)	18	28
Frequently (4-7 times)	63	33

The shortage of milk is possibly one factor which discourages the eating of porridge

Proprietary breakfast cereals are not important rivals to porridge in the traditional breakfast Sixty per cent of men and 60 per cent of women did not consume any during the survey Among those who did, the calories obtained from this source were few, as none ate more than 10 oz in the week Again shortage of milk and perhaps the high "points" value of these proprietary foods may have limited their consumption

A small amount of oatmeal was consumed as oatcake Twenty-five per cent of both men and women took up to 10 oz during the week, but for none of the students was this an important food

Potatoes—The recorded consumption is shown in Table VII

TABLE VII

RECORDED CONSUMPTION OF POTATOES

Oz. consumed per week	Number of students	
	Men	Women
0-9	0	6
10-19	1	13
20-29	12	44
30-39	16	39
40-49	18	26
50-59	25	9
60-69	14	5
70-79	13	2
80 and over	9	1

No difference existed between those at home and those in lodgings, but it is clear that the men consumed much more than the women At the time of the survey potatoes were rationed, the weekly allowance being 3 lb This weight, of course, includes the peel, whereas the recorded consumption in Table VII does not Fifty-six per cent of men and 12 per cent of women students recorded an intake of over 50 oz in the week Of these big potato-eaters, a few complained of the small size of helpings in restaurants and clubs, but none of any shortage at home or in lodgings The extra potatoes were obtained in a variety of ways, some had supplies sent in from the country, others had access to private gardens or allotments, some depended on stores laid in before rationing started, and not a few stated that their greengrocers were meeting their needs in full A large proportion of women, probably about 50 per cent, did not eat their full ration No doubt much redistribution of rations occurred within families

Vegetables—The recorded consumption of vegetables (other than potatoes) is shown in Tables VIII and IX Table VIII gives cooked weight of green vegetables—cabbages, brussels sprouts, cauliflowers, spinach, lettuces, etc Table IX refers to other vegetables such as carrots, turnips, swedes, beetroots, parsnips, onions, leeks, peas, beans, etc

TABLE VIII

RECORDED CONSUMPTION OF GREEN VEGETABLES

Oz. consumed per week	Number of students	
	Men	Women
0-5	73	91
6-10	25	34
Over 10	10	20

TABLE IX

RECORDED CONSUMPTION OF OTHER VEGETABLES

Oz consumed per week	Number of students	
	Men	Women
0-10	52	79
11-20	47	47
21-30	7	18
Over 30	2	1

In neither case was any difference found between those living in lodgings and those at home

These figures do not include the vegetables employed in making soups Scotch broth is a traditional dish, consisting of a vegetable soup usually, but not always today, thickened with barley or other cereals The weekly recorded consumption is given in Table X

In those students taking less than a pint a week (about half the total number) this source of vegetables is negligible In some of the others it may represent a very considerable intake

TABLE X

RECORDED CONSUMPTION OF SCOTCH BROTH

Pints consumed per week	Number of students	
	Men	Women
Up to 1	45	78
1 to 2	41	50
2 to 3	13	15
3 and over	9	2

Fruit.—During the period of the survey there was an abundance of oranges and grapefruits in the shops of Edinburgh. Tomatoes could also be obtained without difficulty. Table XI shows that, whilst some students ate large amounts of fruit, others took no advantage of the plentiful supplies available. Considerable differences existed both between the sexes and between those at home and in lodgings. Women ate more fruit than men, and those at home more than those in lodgings.

TABLE XI

RECORDED CONSUMPTION OF FRESH FRUIT

Oz. consumed per week	Numbers of			
	Men at home	Men in lodgings	Women at home	Women in lodgings
0-10	9	16	8	12
11-20	14	18	12	17
21-30	9	5	19	15
31-40	11	3	8	10
41-50	8	1	6	8
Over 50	10	4	18	12

Meat and Flesh Foods.—During the period of the survey the domestic ration of fresh butcher's meat for an adult was a shilling's worth. The amount purchased varied according to the quality of meat chosen. Table XII gives recorded consumption of fresh meat, including any obtained in restaurants and canteens. A few of the very low intakes are due to the student's not consuming his ration within the period of the survey.

Poultry, game, liver, and kidney were available as an additional source of fresh meat. These foods were unrationed, but not readily available and expensive. About half the men and one-third of the women had small quantities (up to 8 oz.) of meat in this form during the week. Only eight men and three women had larger amounts.

An additional source of meat are the "made-up" meat dishes such as sausages, meat pies, rissoles, mince, haggis, etc. The meat in these is always diluted with a considerable proportion of flour or other component. Nevertheless, these foods do provide a considerable additional source of animal protein. Table XIII gives recorded consumption of "made-up" meats.

TABLE XII

RECORDED CONSUMPTION OF COOKED EDIBLE FRESH MEAT

Oz. consumed per week	Number of students	
	Men	Women
Less than 4	2	11
4 to 7	34	68
8 to 11	34	41
12 to 15	28	22
16 and over	10	3

TABLE XIII

RECORDED CONSUMPTION OF MADE UP MEATS

Oz. consumed per week	Number of students	
	Men	Women
Less than ½	11	44
½ to 1	31	69
1 to 1½	39	25
1½ to 2	15	5
Over 2	12	2

The bacon ration throughout the survey was 2 oz. a head weekly. The great majority of students were probably eating this amount and no more. Actual figures obtained in the survey show variations which are probably due to the fact that people sometimes consume two weeks' ration of bacon in one week and none in the next. Very few (about 5 per cent.) do not like bacon, and a correspondingly small number manage to get hold of these rations.

Throughout the survey fish was unrationed and readily available. Almost all students took advantage of this. Table XIV gives consumption of fish. The commonest kinds of fish eaten were herring and haddock, kippers, especially at breakfast, and cod, often served in restaurants. Almost all the quantities recorded represent fresh fish, fish cakes and other made-up dishes occurring comparatively rarely. Fish consumption appeared to be the same in lodgings as at home.

TABLE XIV

RECORDED CONSUMPTION OF FISH

Lb consumed per week	Number of students	
	Men	Women
Less than ¼	8	18
¼ to ½	28	30
½ to ¾	21	39
¾ to 1	17	31
1 to 1¼	23	24
1¼ to 2	9	3
Over 2	2	0

Dairy Produce—Milk, Cheese, and Eggs—At midwinter, milk production is at its lowest and the normal adult ration of two pints per week is a small allowance for a tea-and-coffee-drinking population such as the students The great bulk of the milk was consumed in these beverages and only small amounts were left over for porridge, breakfast cereals, and puddings, and normally none for drinking as milk The assessments of amounts of milk taken in tea and coffee is difficult In 196 cases, the records indicated, and the students confirmed at interview, that only the ration of milk was being taken, with the addition of small quantities in tea and coffee at outside restaurants Ten students indicated that they were not getting two pints per week. Of these, five women and one man stated that they disliked milk and seldom had it, even in tea or coffee The remaining four were in lodgings and thought that they were not supplied with their due of milk Forty-seven students (18 per cent) recorded over two pints per week in addition to milk in tea and coffee Of these, eleven lived in the country with access to farms, twenty-eight ascribed their good fortune to having a "good" milkman, and eight confessed to living in homes where there was priority milk or had friends or relations who disliked milk None of them was eligible for more than the standard ration The findings are summarized in Table XV

Of the 18 per cent reckoned to have got more than two pints exclusive of milk in tea and coffee, the assessed intake is given in Table XVI

TABLE XVI

RECORDED MILK CONSUMPTION OF STUDENTS WITH ACCESS TO AN EXTRA SUPPLY OF MILK

Pints of milk consumed per week	Number of students
2–2 9	15
3–3 9	13
4–4 9	9
5–5 9	4
6–6 9	3
7–7 9	1
8–8 9	1
over 9	1

Cheese was rationed at 2 oz. a head weekly In contrast to bacon and milk, of which foods most of the students consumed approximately the allotted ration, there was wide variation in the taste for cheese Almost one-third, with equal proportion of men and women, stated that they did not like cheese Some never ate it at all and others only ate it in cooked dishes such as savouries, macaroni cheese, etc. There is *considerable* competition amongst cheese-eaters for the unconsumed ration of the cheese-haters Some complicated bartering systems existed A few students were eating two, three, or even four times the official

TABLE XV

MILK CONSUMPTION

	Numbers of students				
	Men		Women		
	Home	Lodgings	Home	Lodgings	Total
Ration only	44	42	47	63	196
Less than 2 pints					
Dislikes milk	1	—	3	2	6 } 10
Not provided	—	1	—	3	4 }
More than 2 pints					
Lives near a farm	3	—	8	—	11 }
Has a 'good" milkman	11	3	9	5	28 } 47
Other sources	2	1	4	1	8 }

ration, and would have liked more Some of the big cheese-eaters got extra supplies from overseas parcels The survey showed that the vagaries of human taste thwarted the good intentions of those who would equitably distribute this source of first-class animal protein

The allocation of eggs in Edinburgh varied slightly during the period of survey, but an average of two per week was available from grocers Table XVII shows the number of shell eggs recorded Again there is no significant difference between those living at home and in lodgings Only twelve students did not have at least one egg in the week, and, of these, two never ate eggs in any circumstances

TABLE XVII

RECORDED CONSUMPTION OF EGGS

Number per week	Number of students	
	Men	Women
0	2	10
1	18	34
2	29	33
3	20	33
4	21	25
5	11	5
6	4	2
7 and over	3	3

Some reported that the week of the survey was exceptional in that an allocation of three or four eggs was made to compensate for previous deficits Nevertheless, at least half the students had sources of supply beyond the allocation Of these sources, back-garden hens and friends in the country were the commonest In addition to shell eggs, dried egg powder was consumed by most students This is often incorporated into puddings and cakes, and the amount eaten by individual students cannot be assessed accurately

Fats—During the survey the ration of fats was 8 oz. per week, of which 3 oz were butter, 4 oz. margarine, and 1 oz. cooking fat Table XVIII gives recorded consumption of fat spread on bread (table fat) but excludes fat used in cooking.

Fat rationing was strictly enforced at the time and few students had access to an extra-ration supply Only two got extra fat from overseas parcels, and two more from farm butter Nevertheless, as Table XVIII shows, at least a quarter of the students recorded a consumption greater than 6 oz. of table fat a week, which, allowing only 1 oz of margarine for cooking, means that they almost certainly ate

TABLE XVIII

RECORDED CONSUMPTION OF TABLE FAT

Oz. consumed per week	Number of students	
	Men	Women
0	0	1
1	3	3
2	11	17
3	18	36
4	18	37
5	19	23
6	17	16
7	12	7
8 and over	10	5

more than their ration They were probably able to do this because of unequal distribution within the household For example, many of those in lodgings shared rooms with a fellow lodger, who did not eat his or her share Many who are small bread-eaters do not require the full fat ration Of the big fat-eaters living at home, most admitted to consuming part of their parents' ration, and one young man with a large appetite had, in addition, established a regular lien on a portion of his grandparents' fat ration

Sugar and Jams—During the period of the survey the sugar ration was 8 oz. and the jam ration 4 oz. a head weekly The sugar was consumed mostly in tea, on porridge, and on puddings Very few students had extra sources of supply, and the great majority consumed their ration, and their ration only, in this way As regards jam consumption, there was wide variation A few, especially amongst the small bread-eaters, did not eat their full ration, but many others consumed amounts considerably in excess of their weekly ration This was to be expected since jam can be stored and in some families, apart from unequal consumption by individual members, substantial supplies of home-made jam are laid down during the fruit season

Beverages—The principal drink of students of both sexes was found to be tea Diaries recorded an average consumption of tea seventeen times in the course of a week Variations from this average were small, and it is quite exceptional for a student not to have tea at least twice a day The majority have milk in their tea, and a large proportion of the milk ration is taken in this way

Coffee is the second most important beverage being taken on an average five times a week However, many students drink it twice a day or more, others seldom or never Coffee is drunk more in the Unions and restaurants than at home

or in lodgings As these are frequented mostly by students living in lodgings, the latter consume more coffee than those living at home

Cocoa was taken on an average twice a week but with wide individual variations Not more than one-third of the students ever drank National Milk Cocoa

Beer consumption is shown in Table XIX

TABLE XIX

RECORDED BEER CONSUMPTION

Pints of beer drunk per week	Number of students	
	Men	Women
Never	54	78
Occasionally	30	60
1 pint	10	5
2 pints	2	—
3 pints	4	1
4 pints	3	—
5 pints and over	5	1

In addition small quantities of wine and spirits were taken by six men and twelve women Of those taking part in the survey 83 per cent of men and 91 per cent. of women stated that they either never drank or only did so on special occasions These figures confirm a general impression that present-day Edinburgh students are both abstemious and sober Apart from any other considerations, the high taxation on alcoholic drinks must restrict their consumption

Tobacco —At the interviews the students were asked their usual consumption of tobacco, and this is shown in Table XX

TABLE XX

RECORDED NUMBER OF CIGARETTES SMOKED

Smoking	Number of students	
	Men	Women
Not recorded	21	16
Never	56	86
Occasionally	6	20
Cigarettes 5 a day	7	11
,, 10 a day	12	9
,, 20 a day	2	3
Tobacco 1 oz per week	1	—
,, 2 oz per week	2	—
,, 3 oz, per week	1	—

It will be seen that 62 (71 per cent) of the men and 106 (82 per cent) of the women never smoked or only did so occasionally As in the case of alcohol, it is probable that high taxation acted as a deterrent

THE PATTERN OF STUDENT MEALS

A statement such as we have given, of total food intake of a group of people over a short period, provides an incomplete picture of the quality of their diets It is important to know also how food consumption is spread throughout the day, how many meals are taken, and how these are related to social customs and working habits A reader of the classical literature of any country will be aware how variable and changeable such human food habits are

The present surveys show that with rare exceptions Edinburgh students eat their food in three main meals These are a breakfast in the early morning, usually between 7 30 and 8 30 a m , a mid-day meal taken between noon and 1 30 p m., and an evening meal between 5 30 and 8 p m In addition most students have light refreshment or a snack at least once during the day Snacks are usually taken at the middle of the forenoon or the middle of the afternoon or late at night before retiring to bed Thus there are students who eat six times a day, others who have only three meals, but the majority eat between four and five times a day We know little about how these varying habits affect human well-being and effective working Human physiology has no precise information about the size of meals or the intervals between them that are optima for health That adequate opportunity for the eating of proper meals is essential for efficient working is now widely realized, many practical industrialists and combatant officers in the Services have given considerable thought to the pattern of the meals of the men and women for whose health they are responsible An account of the distribution of students' food intake throughout the day is relevant to considerations of student health

Breakfast —The day is usually begun with a meal in which bread with butter or margarine and marmalade or jam, together with tea (or occasionally coffee) are consumed In addition this meal may include either or both oatmeal porridge and a cooked dish The latter is usually an egg, bacon, sausage, kipper, herring, or other fish, and is important as providing a supply of animal protein Meals with these additions conform to traditional Scottish and English customs Without them a breakfast can be described as continental The table shows the percentage of students consuming

each type of breakfast Not a few students had grapefruit on occasions, but otherwise fruit was rarely and vegetables hardly ever taken Those who took porridge usually had the major portion of their milk ration at breakfast The figures shown in the table are averages for the seven days in the week Daily average figures show uniformity for the six weekdays, but on Sunday there is a great reduction in the number of those taking porridge and an increase in those eating cooked dishes—up to 80 per cent of all students Indeed, Sunday morning is frequently an occasion on which the limited week's ration of eggs and bacon is consumed in entirety

TABLE XXI

PERCENTAGE OF STUDENTS CONSUMING A GIVEN TYPE OF BREAKFAST

	Men		Women	
	Home	Lodgings	Home	Lodgings
Porridge and cooked dish	20	41	8	19
Porridge only	29	11	13	9
Cooked dish	29	42	43	57
Continental type	22	6	36	15

These figures illustrate several features of students' breakfasts Firstly, as already noted, they show that porridge is consumed regularly by only half the men and a small minority of the women Secondly, more cooking for breakfast is done in lodgings than in the homes Thirdly, men students tend to consume a more substantial breakfast than women A striking feature is the large numbers who leave home for their day's work fortified only by tea or coffee and bread or toast No less than 36 per cent of women and 22 per cent of men living at home come within this category These have abandoned the traditional breakfasts of the country The strict rationing of eggs and bacon and the limited supply of sausages and offal such as kidney, liver, etc, makes the task of procuring suitable foods for breakfast difficult and demands skill and patience in shopping It is notable that in this respect landladies appear to be appreciably more effective than mothers Some of those eating only small breakfasts do so from choice They lie late in bed and have neither the time nor the inclination for a proper meal before setting out for work. These are for the most part girls Those students who have to travel far from homes in the country must perforce rise earlier than others, yet they usually got good breakfasts

The fact that large numbers of students come to classes without proper meals in the morning is an important factor contributing to the habit of taking mid-morning snacks

The Mid-day Meal—The great majority of students eat their mid-day meal either at a University Union or a city restaurant This is shown in Table XXII

TABLE XXII

PLACE OF TAKING MID-DAY MEAL

Students' living location	Percentage lunching out
In lodgings	86
At home 20 minutes or more from the University	80
At home within 20 minutes of the University	46

A small proportion of landladies (about 10 per cent) provide mid-day meals for students The majority only contract to supply lunches on Saturday and Sunday Students living in such lodgings are therefore forced to go elsewhere for their mid-day meals

The chief factor determining where a home-student eats at mid-day is the time available This depends both upon travelling time and teaching schedules Of the 130 students living at home, travelling times were as follows

Twenty minutes or less	35%
21 to 30 minutes	29%
31 to 60 minutes	23%
Over one hour	13%

Those living more than twenty minutes away are all forced to find their lunch out, except for a few Arts students who only occasionally have a class in the afternoon and who can return home to lunch and study at leisure In general the luncheon interval is ample in the Arts faculty, limited in the Medical faculty, and often very limited in the Science faculty and first year in Medicine This is reflected in students' lunching habits Thus 33 out of 57 (58 per cent) Arts students living at home have mid-day meals at home, but only 3 out of 52 (6 per cent) Medicals and 1 out of 23 Science students The majority of these students who have the time prefer to go home for their mid-day meal rather than lunch out How big this majority is we cannot be sure, but it certainly is not less than 58 per cent, the figure for all Arts students On

being questioned, these have repeatedly assured us that there was always plenty of food at home We looked for, but could find no correlation between the lunching habits and the number of ration books available to the housekeeper

It was clear that the University Unions were more popular than city restaurants On any given day the percentage of all students eating out, who used the Unions, was as follows

Men living at home	87%
Men living in lodgings	71%
Women living at home	70%
Women living in lodgings	67%

Those who did not use the Unions all complained of the poor service and overcrowding there They stated that they were able to get meals quicker elsewhere There was almost unanimity amongst the men that the Union provided as good a meal at as cheap a price as any city restaurant Most of the women supported this opinion, but a considerable minority complained of lack of variety in the menus and of lack of imagination in the cooking and catering The main complaint was of the service, and this was undoubtedly insufficient in both Unions The strictly enforced segregation of the sexes compelled a few students to seek their lunch outside the Union

As regards the quality of the mid-day meal, great variations exist We have arbitrarily defined a lunch as a meal consisting of (1) a helping of meat, egg, fish, or cheese, and (2) one helping of either potato, vegetable, or fruit, with the addition of (3) either a cooked pudding or soup Any mid-day meal not fulfilling these standards has been called a snack This distinction is based on custom and experience rather than nutritional standards It has no quantitative significance and indeed many snacks provide more calories than some lunches It is, however, a qualitative distinction of value A snack, as we have defined it, usually is deficient in some of the essential dietary constituents, either animal protein, minerals, or vitamins Consequently those students who only had snack meals at mid-day were dependent on extra sources of protective foods at breakfast or in the evening to balance their daily diet The percentage having snack lunches were as follows

Men living at home and eating out at mid-day	24%
Men living in lodgings and eating out at mid-day	31%
Women living at home and eating out at mid-day	28%
Women living in lodgings and eating out at mid-day	31%

It will be seen that just under one-third of the students obtain mid-day meals which leave a leeway to be made up by extra foods of higher nutritional value at other meals The principal cause of this failure to obtain a proper lunch is the lack of staff and facilities at the Unions to serve lunches within the limited times available for the student The Men's Union, the Women's Union, and the King's Building Common Room are all unable to meet demands in this respect Students have repeatedly complained to us of the poor service in the main dining rooms The majority of those who eat snacks do so because it enables them to get some food within the time available between classes In general snack meals are cheaper than proper lunches and a few students may be economizing in this manner We do not believe this to be an important factor There have been no complaints about the prices charged in Unions only one student has specifically admitted attempting to save money on lunch

The Evening Meal —Two distinct types of meal are served in the evening These may be described as dinner and high tea They have very different origins in social evolution Dinner, for which we have used the same arbitrary criteria as those already laid down for lunch, is generally the main meal of the day for the household, it is the meal for which there is most cooking and preparation For several generations it has been the custom of the upper strata of society, including the professional classes, to eat the main meal of the day in the evening This was generally satisfactory for those households with an adequate domestic staff, but as more and more housewives have failed to obtain domestic assistance and have had to cook and prepare the family meals themselves, there has been an increasing tendency to follow the custom of the labouring classes and lower middle classes and make the mid-day meal the chief meal of the day The evening meal is then usually a high tea, a meal which, in addition to bread, butter, jam and cakes, contains a cooked dish, usually providing a single source of animal protein, e g meat, sausages, cheese, fish, or egg Characteristically no puddings or vegetables are taken We have defined high tea as an evening meal not conforming to the criteria laid down for dinner, but containing one cooked dish These distinctions are not hard and fast, on occasions it may be difficult to decide whether a given meal is really high tea or a dinner Any meal which did not qualify as a high tea was regarded not as an evening meal but as a snack This classification of meals will be seen to be essentially a distinction based on the amount of cooking involved in the

preparation of the meal, and not on its calorie content

The figures arrived at by this means are given in Table XXIII They represent percentages of the men and women in the four groups, and are overall figures for the week of the survey

TABLE XXIII

PERCENTAGES OF STUDENTS HAVING DIFFERENT TYPES OF EVENING MEALS

	Men		Women	
	Home	Lodgings	Home	Lodgings
Dinner	16	34	10	35
High tea	72	67	70	55
No cooked meal	12	6	20	10
Two meals on same evening	6	5	2	1

This table shows, too, that a third of the students in lodgings have dinner regularly in the evening, and only one-eighth of those at home Also the number of women students on any particular evening who did not get a cooked meal is nearly twice as large as the number of the men, with a maximum of one student in five for those women living at home The fact that the majority of students had a high tea rather than a dinner would be of little significance nutritionally, if indeed they had previously had a satisfactory lunch It is the combination of snack mid-day meal and high tea which is unsatisfactory The numbers of students having this combination of meals on two or more of the five working days of the week was noted Expressed as a percentage of the numbers in each group, they are given in Table XXIV Such a combination inevitably means an inadequate consumption of vegetables during the day, and indeed is responsible for the large numbers of students, already referred to, who, throughout the week, have a small vegetable intake Since the majority of students have no dinner at night, it becomes all the more important that arrangements should exist to enable them to get an adequate lunch

Students in lodgings appear to have dinners at night more often than those at home This, no doubt, is due to the fact that most landladies do not provide mid-day meals and instead cook in the evenings Mothers prefer to do most of their cooking at mid-day

The figures for those having two cooked meals in the same evening, and to a large extent those having no freshly cooked meal also, are accounted for by social engagements and other functions which upset the normal pattern of meals Only nine students (five of them living at home) had as a regular feature of the diet no cooked food in the evening

When analysed on the basis of days of the week the most striking feature of the data was the deterioration of the evening meals at the week-ends, both in the homes and in lodgings A decrease in the number of students having dinner and an increase in those having no cooked food in the evening was very pronounced on Saturday and Sunday This is related to the increased number eating cooked mid-day meals on these days

Snacks—In addition to the three main meals, most students had one or more snacks during the day These snacks consist of either tea or coffee and a variety of buns and cakes Very variable amounts of food were eaten A few students obtain a considerable proportion of the total calories of their diet from snacks Snacks characteristically contain no cooked meat or vegetables, but a little fruit was sometimes eaten Three times were commonly set aside for snacks. Firstly, from 11 o'clock till 12 noon, when coffee is usually drunk, secondly, from 3 30 to 4 30 p m when tea is taken, which is often additional to the main high tea consumed later, lastly, at 10 p m or later, a majority of the students had a late snack, usually tea and buns

TABLE XXIV

PERCENTAGE OF STUDENTS HAVING SNACK LUNCH AND HIGH TEA ON TWO OR MORE WORKING DAYS

	Home	Lodgings
Men	20	17
Women	25	16

TABLE XXV

PERCENTAGE OF STUDENTS CONSUMING SNACKS (AVERAGE OF SEVEN DAYS)

	Men		Women	
	Home	Lodgings	Home	Lodgings
Eleven o clock	28	30	33	34
Afternoon tea	29	31	38	50
Late snack	70	79	71	73

This, no doubt, is associated with the early hour at which the evening meal is usually eaten in Edinburgh About one-third have coffee, usually with a cake or bun, at mid-morning The table shows that more women than men had an afternoon tea, this is a reflection of the fact that women more often than men miss a main cooked evening meal On

such occasions afternoon tea had to do duty as the principal meal

Discussion and Conclusions

1 A diet survey of 298 students under 21 years of age at Edinburgh University was carried out in December, January, and February, 1947-48 The survey was carried out by a log-book technique and each student's diet was recorded for one week

2 There was no real shortage of calories or of energy-yielding foodstuffs We did not find a single student who was unable to satisfy his or her appetite While it can be stated with certainty that no student has normally gone to bed hungry, not a few have on occasions found their mid-day meals insufficient Many students of both sexes consumed bread and potatoes in quantities far beyond the ration at the time of the survey Had the supply of these two foods (at 63 oz and 3 lb per week respectively) been strictly confined to the individuals own domestic ration, many would have suffered discomfort and some real hardship

3 Calculated recorded consumption of protein, animal protein, and fats seemed sufficient for health This is not to say that many students would not have liked more

4 The enforced consumption of bread made from National flour insured that intakes of vitamin B_1 were adequate The consumption of calcium by most students was also sufficient

5 The amount of fresh fruit and vegetables eaten was very variable and a minority of students ate small quantities of those foods Ten per cent of all students did not consume an average of three ounces a day of fruits and vegetables (excluding potatoes) together This low intake of protective foods is reflected in an intake by some students of vitamin A and of vitamin C in amounts below acceptable physiological standards (Table III)

6 It is difficult to judge how these dietary deficiencies affect student health It can be stated quite definitely that the quantities of vitamins consumed were always sufficient to prevent manifest clinical evidence of vitamin deficiencies in any of the students surveyed.

We investigated forty women medical students, most of whom had taken part in the survey, and showed that 10 per cent suffered from mild anaemia (haemoglobin levels less than 90 per cent Haldane) This finding is in no way unexpected Indeed a proportion of women existing on diets such as have been described would be likely to have substandard haemoglobin levels

7 The minority of students on an ill-balanced diet was evenly distributed amongst both sexes and amongst those living at home and in lodgings The diets of those in University hostels were on the whole well-balanced

8 From our interviews with students we would consider that a lack of elementary knowledge of human physiology was more important than a lack of money in determining bad feeding Even at University level there is a real need for elementary health education

9 At the start of the survey we were told that we should find many bad landladies This has not proved so The majority of landladies looked after their student lodgers well, not a few appeared to give food and services out of all economic proportion to the rent paid In times of food shortages, such as the present, a great premium is put on domestic efficiency A small minority of women failed to provide proper meals, but in our opinion the inefficient landlady is no more common than the inefficient mother

10 Some students come from broken homes, in which one or both parents were absent, either on account of death or matrimonial separation or distant employment The absence of either parent from the home was found usually, but not inevitably, to be reflected in inferior feeding Irregular meals, limited cooking, and unsatisfactory diets were observed in broken homes

11 The facilities provided at the University Unions and the Science Buildings Common Room for mid-day meals were inadequate Poor mid-day meals were a feature of many bad diets Large numbers of students had no proper lunch This was in no way the fault of the catering staffs who, for the most part, were doing excellent work with insufficient accommodation and equipment

12 The survey showed that, judged by chemical standards, the diets of the majority of the students were satisfactory We were perhaps more impressed by the social aspects of the feeding of students Each evening most students sup quietly at home with their families or in their lodgings Exceptions to this are few even on Saturday nights Undergraduate parties are *not* a feature of University life today in Edinburgh We have already mentioned that four out of five men and nine out of ten women passed the week without being exposed to the socializing influence of alcohol The garnishings of meals are absent In Edinburgh University today a meal is a physiological action, it is rarely a social occasion The social and economic factors which have brought about these changes are not within our present scope We simply record that food no longer serves as a background for that essential function of a university—the exchange of ideas

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MORTALITY FROM RHEUMATIC HEART DISEASE IN CHILDREN AND YOUNG ADULTS IN ENGLAND AND WALES

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INTRODUCTION

In the last few years considerable attention has been paid to the rheumatic diseases and, in particular, rheumatic fever Glover (1943, 1946) has shown that the mortality from the latter has declined considerably in the last sixty years and that recently this decline has been accelerated On these grounds he called acute rheumatism an obsolescent disease In contrast, Morris and Titmuss (1942), Parkinson (1945), and Ryle (1946) have called attention to the heavy toll still taken by rheumatic heart disease, and to the fact that adolescents and young adults are its main victims

Considerable local and regional differences in the mortality from rheumatic heart disease have been observed in England and Wales (and also in morbidity), and in an attempt to determine the aetiology many workers have related these differences to social and environmental conditions Poverty has been among the chief factors incriminated Reports issued some twenty years ago by the Ministry of Health (1927) and the Medical Research Council (1927) agree that acute rheumatism rarely attacks the children of well-to-do parents Morris and Titmuss hold the view that " the whole complex of poverty " is involved in the production of juvenile rheumatism, and Daniel (1943), in his study of rheumatic heart disease in Bristol, concluded that there was a significant association between its incidence and low family income The suggestion in the Medical Research Council's report that the incidence was greatest in the artisan class is supported by Wilson (1940) but denied by Morris and Titmuss

Bad housing has also been condemned as a cause of acute rheumatism, but the evidence incriminating dampness, ill-ventilation, living in basements, and other features is not clear Overcrowding is often associated with bad housing, and some authorities have held this factor to be important In the Medical Research Council's inquiry (1927) no difference was found in overcrowding levels between rheumatic and non-rheumatic families, and Morris and Titmuss, comparing the mortality rates from heart disease in regions of England and Wales, found the correlation with overcrowding inconclusive Savage (1931) also found no significant association between the incidence of rheumatic heart disease and crowding but, on the other hand, Perry and Roberts (1937) showed that the incidence of rheumatic heart disease in different wards of Bristol was highly and significantly correlated with the average number of persons per room Daniel, in his more detailed study of the same city, confirmed this relationship Clarke (1940) considered that in Dublin juvenile rheumatism was not essentially a disease of poverty but coincided with overcrowding and proximity to low-lying areas

The importance of other factors such as climate, nutrition, maternal care, and heredity is difficult to assess but each has been considered by various authors It is, therefore, impossible to reach definite conclusions from the evidence already available and, in particular, it seems that more information is required on the effects of poverty and housing In this respect it would clearly be preferable to study the morbidity from rheumatic heart disease and its relation to these factors, but as yet notification of rheumatic fever and its sequelae is too recent and too localized to be of value Morbidity statistics are otherwise dependent on special surveys, such as those of Savage, Perry and Roberts, and Daniel The present study, therefore, is limited to mortality data published by the Registrar-General for England and Wales

THE AVAILABLE MORTALITY DATA

In the Annual Statistical Reviews of the Registrar-General there is no separate classification of deaths due to rheumatic heart disease before 1940, when the fifth Revision of the International List of Causes of Death was introduced Even then only those

* Holding a Rockefeller Foundation Fellowship

TABLE I

MORTALITY FROM RHEUMATIC FEVER IN ENGLAND AND WALES, 1921-38

	5-14 years			15-24 years			25-34 years		
	Total deaths in triennium	Average annual death rate per million persons living	% of 1921-23 rate	Total deaths in triennium	Average annual death rate per million persons living	% of 1921-23 rate	Total deaths in triennium	Average annual death rate per million persons living	% of 1921-23 rate
Males									
1921-23	754	71	100	489	51	100	282	36	100
1924-26	753	75	106	513	51	100	217	27	75
1927-29	671	66	93	422	41	80	194	23	64
1930-32	594	60	85	395	39	76	197	22	61
1933-35	582	59	83	334	35	69	198	20	56
1936-38	456	49	69	319	32	63	187	19	53
Females									
1921-23	840	80	100	658	63	100	295	31	100
1924-26	926	94	118	637	60	95	320	33	106
1927-29	808	81	101	588	56	89	297	30	97
1930-32	655	68	85	504	48	76	276	27	87
1933-35	720	74	93	468	48	76	256	25	81
1936-38	573	63	79	362	37	59	206	20	65

deaths for which rheumatism was specifically mentioned on the death certificate are so classified, excluding many for which a rheumatic origin is implied but not stated From 1921 to 1930 the third Revision (1920) of the International List was in use, and from 1931 to 1939 the fourth Revision (1929) Both these lists include a group of causes, "Heart Diseases," for which deaths are tabulated for different administrative areas—county and other boroughs, counties, urban and rural districts For the country as a whole the Registrar-General at the same time tabulated the deaths in sub-divisions of this large group Although the change from the third to the fourth Revision of the International List involved alterations in the sub-divisions, the whole group, Heart Diseases, was practically identical in the two lists Thus the deaths from heart disease in England and Wales were classified under the following sub-divisions in the fourth Revision

International List No 90 Pericarditis
" " No 91 Acute endocarditis
" " No 92 Chronic endocarditis, valvular disease
" " No 93 Diseases of the myocardium
" " No 94 Diseases of the coronary arteries, angina pectoris
" " No 95 Other diseases of the heart

In young persons the deaths from the first three sub-divisions, numbers 90, 91, and 92, are almost entirely rheumatic in origin, while those due to causes numbers 93 and 94 are generally not rheumatic Tabulation of the deaths for the years 1931-33 shows that at ages 5 to 14 years over 90 per cent of deaths debited to heart disease fell under the headings of numbers 90, 91, and 92 At ages 15 to 24 years 86 per cent were so classified, and at ages 25 to 34 years 76 per cent On the other hand at ages 35 to 44 years the proportion falls to only 54 per cent It can reasonably be assumed, therefore, that, up to the age group 25 to 34 years, the broad group entitled heart diseases is a fair measure of the mortality from rheumatic heart disease This is in confirmation of the generally accepted opinion that below 40 years of age nearly all deaths from heart disease are of rheumatic origin

It may also be noted that the mortality rates used in this study have not been extended beyond 1938 for two reasons (*a*) In subsequent years both the deaths recorded in the Statistical Reviews and the estimated populations of England and Wales refer only to civilians (Even where a separate table shows the number of deaths among non-civilians, the population at risk is not readily obtainable) In two of the age groups to be studied the rejection from service in the Armed Forces of those physically unfit might well have influenced the recorded mortality rates considerably, particularly as heart

disease or previous rheumatic fever was a common ground for rejection, (*b*) a further complication lay in the introduction by the Registrar-General in 1940 of the fifth Revision (1938) of the International List already mentioned, and also in the change made at the same time in the manner of selecting the assigned cause for tabulation when more than one cause is mentioned on the death certificate The effect of these changes has been to reduce the number of deaths assigned to heart diseases, so that rates for 1940 and later years are not directly comparable with those up to 1939 Conversion ratios calculated and published by the Registrar-General for comparison of rates before and after 1940 are applicable to rates at all ages but could not safely be used for the selected age groups studied here or for particular areas

The Trend of Mortality in England and Wales

Table I shows the average annual mortality rates from rheumatic fever per million persons living (males and females separately) in England and Wales for each of the six triennia 1921-23 to 1936-38 for the age groups 5 to 14, 15 to 24, and 25 to 34 years Table II is similarly prepared to show the mortality from heart diseases, while Table III combines the two One clear characteristic of the rates shown in these tables is their rather higher level for females compared with males Owing to some sex differences in the time trends of mortality the female excess varies somewhat in degree but, apart from the triennium 1921-23, it is invariably present. Ignoring this triennium the total rate for rheumatic fever and heart disease combined shows an almost constant female excess mortality of 20-25 per cent at ages 5 to 14, a similar though rather more varying excess of 15 to 25 per cent. at ages 15 to 24, and one of 20 to 30 per cent at ages 25 to 34 The discrepancy in 1921-23, in which years the rates on males aged 15 to 24 and 25 to 34 appear unduly high, might possibly be a function of the 1914-18 war, through males being thereby more exposed to the risks of contracting rheumatic fever and of subsequently dying from it In view of this curiously high and seemingly abnormal rate on males it will also be as well to consider the trend of their mortality from 1924-26 onwards, though the rates have, it will be noted, been expressed as a ratio to those of 1921-23

Turning to this trend (see also Figs 1 and 2) the following characteristics may be observed

(*a*) *Ages 5 to 14* Mortality rates both from rheumatic fever and from heart disease were declining between 1924-26 and 1930-32 There was, however, a clear set-back, with a rise in mortality, in 1933-35, this was followed by an accelerated decline Taking the combined deaths of Table III, both sexes show a reduction of mortality of nearly one-third between 1921-23 and 1936-38, and their movements throughout the period have been almost identical

TABLE II

Mortality from Heart Disease in England and Wales, 1921-38

	5-14 years			15-24 years			25-34 years		
	Total deaths in triennium	Average annual death rate per million persons living	% of 1921-23 rate	Total deaths in triennium	Average annual death rate per million persons living	% of 1921-23 rate	Total deaths in triennium	Average annual death rate per million persons living	% of 1921-23 rate
Males									
1921-23	1,287	122	100	2,261	237	100	3,163	407	100
1924-26	1,130	113	93	1,895	188	79	2,200	278	68
1927-29	1,068	106	87	1,950	189	80	2,246	270	66
1930-32	950	96	79	1,929	189	80	2,239	245	60
1933-35	1,047	105	86	1,816	187	79	2388	243	60
1936-38	757	81	66	1,741	177	75	2,317	232	57
Females									
1921-23	1,668	159	100	2,353	225	100	2,972	314	100
1924-26	1,355	137	86	2,312	218	97	2,989	309	98
1927-29	1,316	133	84	2,500	236	105	3,124	318	101
1930-32	1,212	125	79	2,475	236	105	3,254	324	103
1933-35	1,258	129	81	2,285	232	103	3,264	315	100
1936-38	902	99	62	2,042	207	92	3,110	297	95

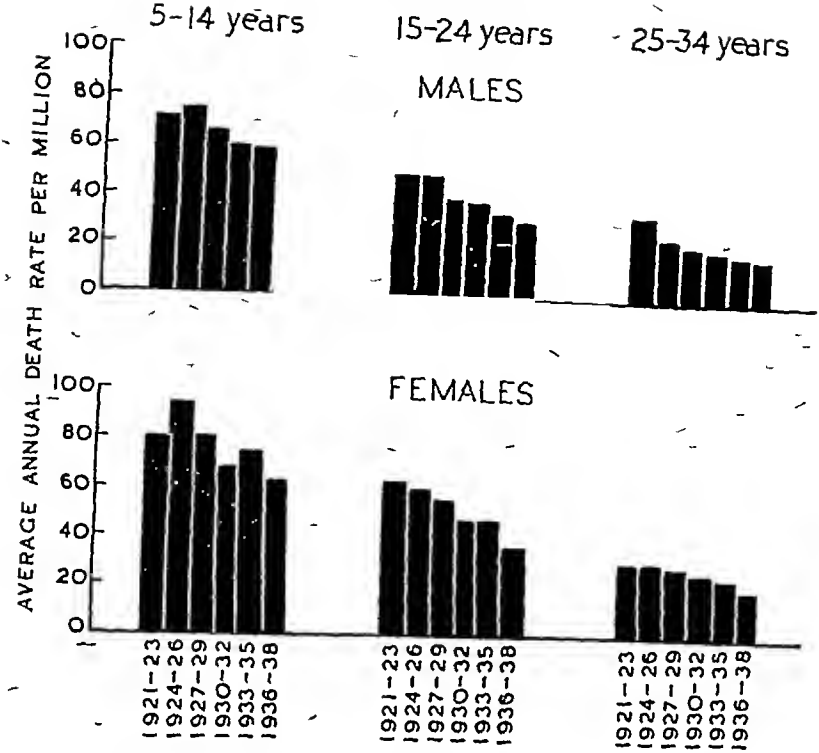

FIG 1.—The trends in mortality from rheumatic fever in England and Wales, 1921-38, in age groups 5 to 14, 15 to 24, and 25 to 34 years

TABLE III

MORTALITY FROM RHEUMATIC FEVER AND HEART DISEASE COMBINED IN ENGLAND AND WALES, 1921-38

	5-14 years			15-24 years			25-34 years		
	Total deaths in triennium	Average annual death rate per million persons living	% of 1921-23 rate	Total deaths in triennium	Average annual death rate per million persons living	% of 1921-23 rate	Total deaths in triennium	Average annual death rate per million persons living	% of 1921-23 rate
Males									
1921-23	2,041	193	100	2,750	288	100	3 445	443	100
1924-26	1,883	188	97	2,408	239	83	2,417	306	69
1927-29	1,739	172	89	2,372	230	80	2,440	294	66
1930-32	1,544	156	81	2,324	228	79	2 436	267	60
1933-35	1,629	164	85	2,150	222	77	2,586	263	59
1936-38	1,213	130	67	2,060	209	73	2,504	251	57
Females									
1921-23	2,508	240	100	3 011	288	100	3,267	345	100
1924-26	2,281	230	96	2,949	278	97	3,309	342	99
1927-29	2,124	214	89	3,088	292	101	3,421	348	101
1930-32	1,867	192	80	2,979	285	99	3,530	351	102
1933-35	1,978	203	85	2,753	280	97	3,520	340	99
1936-38	1,475	162	68	2,404	244	85	3,316	317	92

(*b*) *Ages 15 to 24* At these ages the trend has clearly been less favourable than that found for schoolchildren The death rates attributed directly to rheumatic fever have, it is true, declined more rapidly than at ages 5 to 14, but those due to heart disease—and these form the larger component—have shown practically no change in either sex between 1924-26 and 1936-38 The sum of the two shows a slightly falling rate for males from 1924-26 onwards (ignoring the unduly high rate of 1921-23), while for females there is virtually no change between 1921-23 and 1933-35 but some decline in the final three years, 1936-38

(*c*) *Ages 25 to 34* These ages give very much the same picture as the previous group, namely a steady and considerable decline in the deaths attributed directly to rheumatic fever from 1924-26 onwards but relatively little change, particularly for women, in heart disease, which is numerically much the more important group In total, therefore (again ignoring for reasons given the male figure for 1921-23) there has been only a slight decline in the death rate of males and practically no improvement at all in the death rate of females

This general inter-war picture is hardly a favourable one It seems that the substantial fall since 1924-26 in rheumatic fever mortality in each age group and for each sex was largely offset except at the school ages by the lack of decline in the mortality from the heart disease attributable to rheumatic fever At the school ages, 5 to 14, there was indeed quite substantial improvement in total though some of this was concentrated in a rather sharp fall in the final period 1936-38 At ages 15 to 24 and 25 to 34 there was likewise an improvement in 1936-38, but, apart from this, male mortality was declining only very slowly and female mortality was not declining at all

Mortality in Administrative Areas

It is possible to extend, at least in part, this study of the time changes in mortality since the Registrar-General publishes deaths in regions, county boroughs and rural and urban districts of counties according to an abridged list of causes which includes heart disease as one group This list does not include rheumatic fever which must, therefore, be left out of account The average annual mortality rates from heart disease have accordingly been calculated for London Administrative County, all County Boroughs, all Urban Districts, and all Rural Districts for the three age groups under study and for the periods 1920-22, 1930-32, and 1936-38 For the first two periods the average annual deaths in the three years were divided by the census populations of 1921 and 1931 respectively In the last period the populations had to be estimated on the assumption that the age distribution in all County Boroughs, Urban, and Rural Districts was the same as that in the County Boroughs, Urban, and Rural Districts outside Greater London, estimates of these latter populations being given by age and sex in the Registrar-General's Text volume These rates and corresponding figures for all England and Wales are set out in Tables IV, V, and VI and shown graphically in Fig. 3

The level of mortality in relation to urbanization may first be noted, and it will be seen that in each of the three age groups London Administrative County had the highest rate in 1920-22 (except

TABLE IV

Mortality from Heart Disease, 5 to 14 years, in Administrative Regions of England and Wales in the Triennia 1920-22, 1930-32, and 1936-38

	Males					Females				
	Average annual death rate per million persons living					Average annual death rate per million persons living				
	England and Wales	London Administrative County	County Boroughs	Urban Districts	Rural Districts	England and Wales	London Administrative County	County Boroughs	Urban Districts	Rural Districts
1920-22	132	182	148	134	76	173	236	207	160	104
1930-32	96	94	116	97	63	125	140	148	120	88
1936-38	81	100	103	69	57	99	99	126	90	64
	Rate as percentage of 1920-22 rate					Rate as percentage of 1920-22 rate				
1920-22	100	100	100	100	100	100	100	100	100	100
1930-32	73	51	79	73	83	72	59	72	75	84
1936-38	62	55	70	51	75	57	42	61	56	61

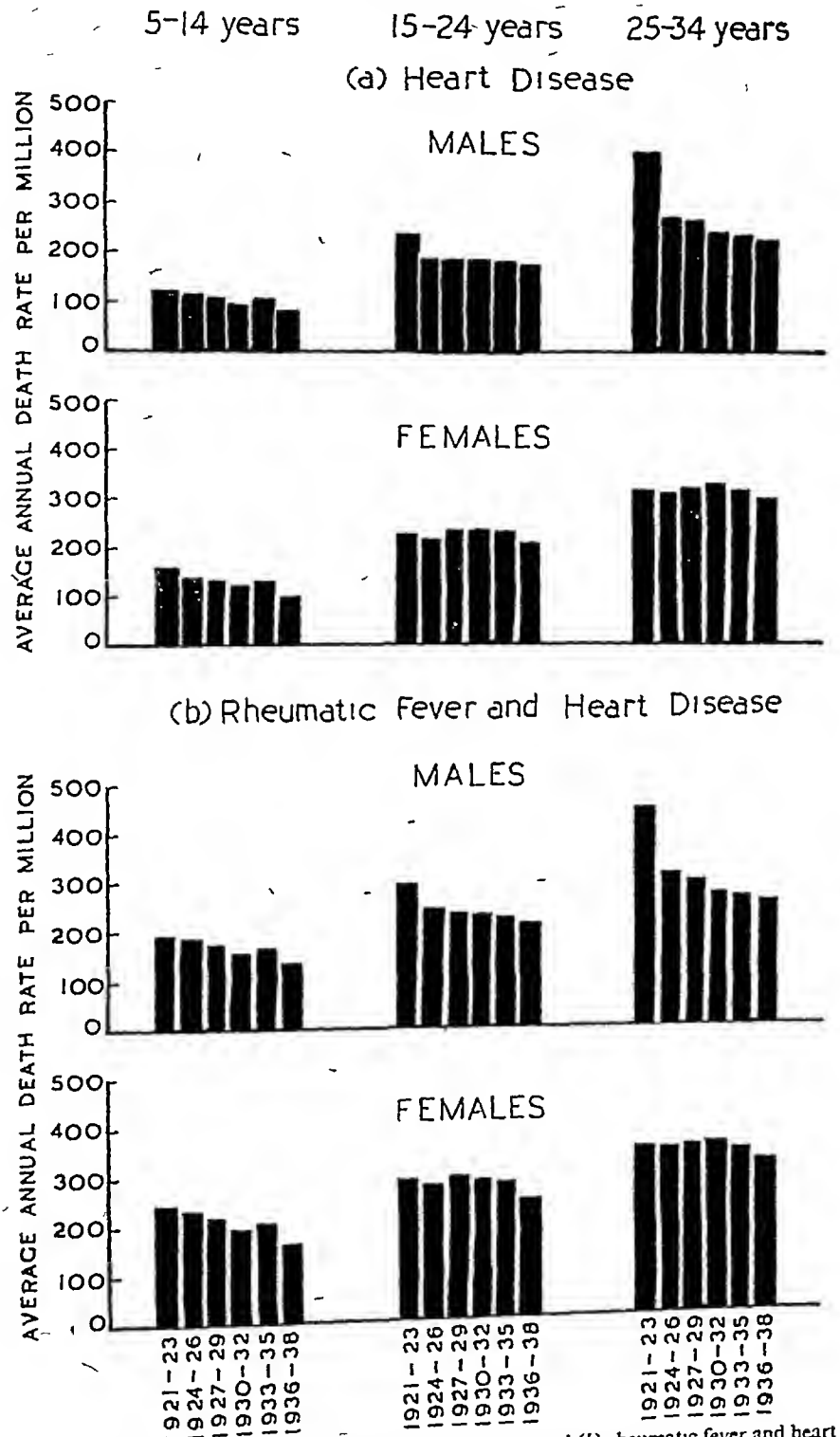

FIG 2.—The trends in mortality from (*a*) heart disease, and (*b*) rheumatic fever and heart disease in England and Wales, 1921-38, in age groups 5 to 14, 15 to 24, and 25 to 34 years

females, 25 to 34) followed, in order, by the County Boroughs, the other Urban Districts and the Rural Districts The death rate of the rural areas is particularly low at ages 5 to 14, when it is only about one-half the rate in the large towns, this advantage falls with increasing age, but it is still considerable at ages 15 to 24 and 25 to 34 With the passage of time this order of mortality has not remained constant, but it appears that the changes lie almost entirely in the discrepant behaviour of the rates for London The other types of areas show death rates for each sex, each age, and each period consistently in the order County Boroughs, Urban Districts, Rural Districts, and their rates of decline between 1920-22, 1930-32, and 1936-38 have, on the whole, been noticeable rather for their general consistency than for their divergencies (though an occasional divergence is apparent) Thus, taking the rates in 1936-38 as a percentage of the corresponding rates in 1920-22 for County Boroughs, Urban Districts, and Rural Districts gives (in that order) the following ratios 5 to 14 males, 70, 51, 75, females, 61, 56, 61, 15 to 24 males, 75, 68, 71, females, 98, 83, 87, 25 to 34 males, 54, 53, 45, females, 89, 92, 85 As was noted previously for the country as a whole, there has been in each of these aggregate of areas (*a*) a substantial fall in the death rate at the school ages, (*b*) relatively little improvement for females either at ages 15 to 24 or at ages 25 to 34, (*c*) for males of these ages a sharp fall in mortality from the high, and possibly abnormal, rates of 1920-22 but only a very slight further decline between 1930-32 and 1936-38

Turning to the County of London it will be seen that at school ages its relatively high death rate fell at first for both sexes more rapidly than the rates for the other administrative divisions, indeed between 1920-22 and 1930-32 its mortality was nearly halved In the ensuing six years no further improvement is found for boys, but there was a still further considerable decline for girls Passing to ages 15 to 24, males again show a more rapidly falling death rate than is apparent for the country as a whole, but this improvement took place almost entirely up to 1930-32 On the other hand the death rate of young women from heart disease showed, in common with the rest of the country, virtually no change between 1920 and 1932 and then an abrupt fall between 1932 and 1938 not apparent in the other areas Finally, at ages 25 to 34, there is no very material difference between the mortality trends of London and elsewhere though the rate has fallen slightly more in London than in the other large towns As one result of these somewhat curious changes the death rates in London, which were in 1920-22 the highest, were in 1936-38 a little below those of the aggregate of the large provincial cities There is no obvious reason why London should have been subject to such relatively high rates in 1920-22 nor why its trend of mortality should have departed so materially from the uniformity revealed by the other groups of areas It might be thought that the answer to the second question might well lie in the special scheme for the treatment and care of cases of rheumatic fever introduced in 1926 by the London County Council It is possible, however, to examine the mortality trends in the Greater London area within and without the scope

TABLE V

MORTALITY FROM HEART DISEASE, 15 TO 24 YEARS, IN ADMINISTRATIVE REGIONS OF ENGLAND AND WALES IN THE TRIENNIA 1920-22, 1930-32, AND 1936-38

	Males					Females				
	Average annual death rate per million persons living					Average annual death rate per million persons living				
	England and Wales	London Administrative County	County Boroughs	Urban Districts	Rural Districts	England and Wales	London Administrative County	County Boroughs	Urban Districts	Rural Districts
1920-22	252	342	285	245	167	240	293	268	227	176
1930-32	188	211	216	185	132	234	288	270	214	166
1936-38	177	200	213	167	118	207	194	262	188	154
	Rate as percentage of 1920-22 rate					Rate as percentage of 1920-22 rate				
1920-22	100	100	100	100	100	100	100	100	100	100
1930-32	74	62	76	75	79	98	98	101	94	94
1936-38	70	58	75	68	71	86	66	98	83	87

TABLE VI

MORTALITY FROM HEART DISEASE, 25 TO 34 YEARS, IN ADMINISTRATIVE REGIONS OF ENGLAND AND WALES IN THE TRIENNIA 1920-22, 1930-32, AND 1936-38

	Males					Females				
	Average annual death rate per million persons living					Average annual death rate per million persons living				
	England and Wales	London Administrative County	County Boroughs	Urban Districts	Rural Districts	England and Wales	London Administrative County	County Boroughs	Urban Districts	Rural Districts
1920-22	457	537	493	435	388	339	369	391	315	267
1930-32	243	284	275	235	181	324	360	359	314	253
1936-38	232	240	267	230	176	297	318	347	288	227
	Rate as percentage of 1920-22 rate					Rate as percentage of 1920-22 rate				
1920-22	100	100	100	100	100	100	100	100	100	100
1930-32	53	53	56	54	47	96	98	92	100	95
1936-38	51	45	54	53	45	88	86	89	92	85

of the Council's scheme Table VII (for which I am indebted to Professor Bradford Hill, unpublished data) shows that at ages 5 to 14 and 15 to 24 the death rate has actually fallen rather more rapidly in areas outside the scheme than in the County areas within it The fall in London appears, therefore, to be a local phenomenon and not easily explained

MORTALITY FROM HEART DISEASE IN SPECIFIC COUNTY BOROUGHS

In view of the fact that mortality has been found to be related to the degree of urbanization of the different areas, an attempt has been made to go a step further and to measure the importance of social and environmental factors in rheumatic heart disease This has been done by correlating the heart disease mortality at ages 15 to 34 years in certain county boroughs with measurable conditions of their population The factors selected were

(i) Social index, i e the proportion per 1,000 total employed males aged 14 years and over belonging to the Registrar-General's Social Classes IV and V. (*Registrar-General*, 1934)

(ii) Persons per room, 1931

(iii) Number of persons per 1,000 living at a density of more than two persons per room, 1931

(iv) Latitude

The first three of these environmental measures are based on the 1931 census of population (the latest available data for the purpose), the mortality rates have therefore been calculated for about the same time It was found that there were so few deaths from heart disease in individual county boroughs at ages 5 to 14 years that reliable rates for this age group could not be calculated To obtain rates based on an adequate number of deaths (as far as possible not less than 20) the age groups 15 to 24 years and 25 to 34 years were combined to give one group 15 to 34 years, and a group of 30 county boroughs was selected by taking all those whose

TABLE VII

DEATH RATES FROM HEART DISEASE PER MILLION LIVING IN LONDON A C AND THE REST OF GREATER LONDON

	5-14 years				15-24 years			
	London A.C		Rest of Greater London		London A C		Rest of Greater London	
	Death rate	% of 1921-22	Death rate	% of 1921-22	Death rate	% of 1921-22	Death rate	% of 1921-22
1921-22	205	100	160	100	308	100	241	100
1931-32	109	53	82	51	249	81	184	76
1933-35	148	72	93	58	227	74	159	66
1936-38	99	48	65	41	197	64	131	54

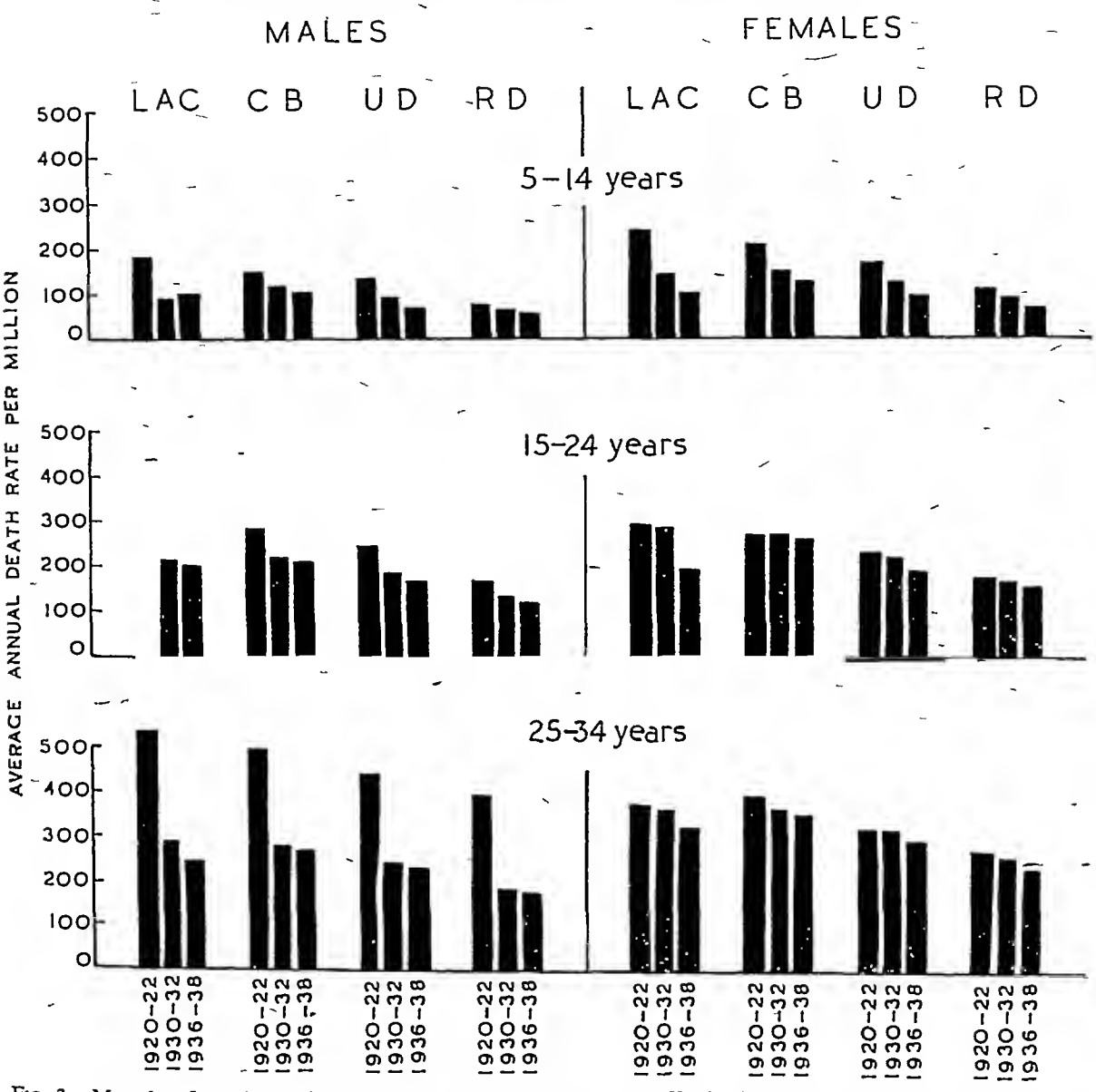

FIG 3.—Mortality from heart disease in administrative divisions of England and Wales in the triennia 1920-23, 1930-32, and 1936-38 in age groups 5 to 14, 15 to 24, and 25 to 34 years

populations in this age group were not less than 20,000 males and 20,000 females (the smallest town selected was Wolverhampton with a population at all ages of 133,190) A mean annual death rate, for males and females separately, was calculated by taking these deaths from heart disease age 15 to 34 in 1931, 1932, and 1933 and relating them to the 1931 census population in the same age group (The triennium 1930-32 would have been preferable but in 1930 the deaths in this age group were not available) The resulting rates for males varied from 64 per million in Brighton to 396 per million in Swansea, with an unweighted average for the 30 towns of 242 per million For females the rates varied from 177 for Brighton to 496 per million for Middlesbrough, with an unweighted average of 320 (see Table VIII)

The correlation coefficients between these rates and the four environmental variables are shown in Table IX, together with the inter-correlations between the four social and environmental factors themselves The significance of the coefficients is

shown both by their standard errors and by the "t" test The coefficients for males and females are, it will be seen, very similar, those between (*a*) mortality and the social index, and (*b*) between mortality and latitude, all being of the order +0 5, and significant, with the two housing indices on the other hand, the coefficients were only about 0 2 to 0 3, and not significant As would be expected, the inter-correlation coefficients between the four social and environmental indices were positive and significant, the lowest being that between persons per room and latitude, +0 44, the highest +0 94 between the two housing indices To allow for these relationships and to assess, so far as possible, the relative influence of the factors measured by the four indices, partial correlations were calculated and are shown in Tables X and XI

The coefficient between male mortality and social index was +0 48 (Table IX) Keeping constant the overcrowding rates, as measured by persons per room, the coefficient is slightly reduced, to +0 39, but is still significant (Table X) The corresponding coefficients for females are 0 54 and 0 47, the latter being still significant Replacing persons per room by the other housing index, proportion at more than two persons per room, the partial coefficients between mortality and social index again remain significant at +0 42 for males and +0 53 for females There was, therefore, in these years an association between the heart disease mortality of each sex in these 30 county boroughs and their social indices, a relationship which appeared to be almost independent of the overcrowding index of the towns

TABLE VIII

MORTALITY FROM HEART DISEASE, AT AGES 15 TO 34 YEARS, IN THIRTY COUNTY BOROUGHS, 1931-33

County Borough	Latitude	Average annual death rate, 1931-33, per million persons living	
		Males	Females
Plymouth	50° 23′	140	204
Portsmouth	50° 48′	149	262
Brighton	50° 49′	64	177
Southampton	50° 55′	181	203
Croydon	51° 22′	138	193
Bristol	51° 27′	183	274
Cardiff	51° 28′	227	268
East Ham	51° 32′	224	342
West Ham	51° 32′	251	432
Swansea	51° 37′	396	322
Coventry	52° 25′	193	246
Birmingham	52° 29′	194	265
Wolverhampton	52° 35′	274	252
Leicester	52° 39′	218	289
Derby	52° 56′	244	281
Nottingham	52° 57′	261	342
Stoke-on-Trent	53° 1′	346	381
Sheffield	53° 23′	309	334
Birkenhead	53° 23′	336	339
Liverpool	53° 24′	319	447
Manchester	53° 29′	310	349
Salford	53° 30′	219	492
Oldham	53° 33′	251	479
Bolton	53° 35′	304	488
Kingston-upon-Hull	53° 45′	282	262
Bradford	53° 48′	204	287
Leeds	53° 48′	290	352
Middlesbrough	54° 35′	259	496
Sunderland	54° 55′	272	241
Newcastle-on-Tyne	54° 59′	212	306

Similarly, for both sexes, the observed relationships between heart disease mortality and latitude are not greatly affected by assuming constant housing indices in the 30 towns, the partial correlations are of the order of +0 45, and significant, while without constant housing indices "r" was of the order of +0 5 Although latitude and housing indices are significantly correlated (Table IX), there being in general a poor standard of housing in the northerly towns, the association between heart disease mortality and latitude cannot, it seems, be explained merely by these differences in housing standards

Keeping constant the social index in these towns the partial coefficients between mortality and latitude became +0 36 for males and +0 30 for females, neither of which are technically significant On the other hand, the partial coefficients between mortality and social index, latitude being kept constant, were +0 30 for males and +0 40 for females, the latter being significant

Lastly, the association between mortality and the housing indices was found to be weak, the coefficients being only 0 2 to 0 3 The partial coefficients when social index or latitude in the 30 towns is kept constant are practically zero The relationship between heart disease mortality and housing indices appears therefore to be fortuitous, being an expression of the bad housing conditions in the more northerly towns and their natural association with lower social classes It seems that the housing conditions *per se* had little effect on the mortality from rheumatic heart disease in these large towns

In short, then, this analysis reveals no association in these 30 large towns between their mortality rates from heart disease in 1931-33 and their concurrent overcrowding indices, but a moderate and significant degree of association between their mortality and both their latitude and their proportion of persons belonging to the two classes lowest in the social

scale Table XII broadly illustrates these associations by showing the unweighted average mortality rates in these 30 towns grouped according to their social index and their latitude It will be seen that for females in all three latitude groups and for males in the most southerly and middle latitude groups the average mortality rate steadily increased as the proportion of employed males in the lowest social groups increased For females the average mortality in the groups with social index under 350 and 350-399 increased with northerliness but for males this association held for the social index under 350 group and only partly for the other two groups

It is difficult to tell exactly what is measured by the social index and therefore the meaning of its association with the heart disease mortality In the depression years of the early 1930's there was considerable unemployment, particularly among the lower social classes, and although unemployment is not taken into account in the calculation of the social index it must have been considerable where there was a large proportion of the working population in classes IV and V The correlation with the social index might indicate, therefore, a high rate of mortality where nutrition in a town was poor Alternatively, an unfavourable social index might indicate lower standards of nursing and care of affected persons and therefore be correlated with increased mortality There is nothing here to indicate whether a higher incidence or a higher fatality rate accounted for the higher mortality rates in some towns, though the studies in Bristol suggest that, where social and environmental conditions are poor, incidence is increased Whether the fatality rate is also high cannot be determined

The relationship between heart disease mortality and latitude was independent of the housing indices but was affected by variations in the social index It is possible that if the social index were a better measure of the factors responsible for increased heart disease mortality, the correlation of mortality with latitude would have disappeared when the social index was kept constant The coefficients were, in fact, not significant technically, but their uniformity suggests that latitude exerted some influence independent of overcrowding or social class Behind it may, perhaps, lie a climatic factor and some aspect of poverty not comprised in the social index

Further enquiry is clearly necessary to explain the relationships between heart disease mortality at these young ages, mainly rheumatic in origin, and social and environmental factors The conflicting evidence from many authorities suggests that the answer is unlikely to lie in a single factor, that none such in isolation could account for the great local differences in the incidence of mortality One of the chief obstacles to solving this and other

TABLE IX

CORRELATION COEFFICIENTS BETWEEN HEART DISEASE MORTALITY, 15 TO 34 YEARS, AND SOCIAL AND ENVIRONMENTAL FACTORS IN THIRTY COUNTY BOROUGHS, 1931-33

	r	Standard error	t	
Males				
Heart disease mortality and social index	+0 48	±0 14	2 88	P< 01
Heart disease mortality and persons per room	+0 30	±0 17	1 66	0 1<P< 2
Heart disease mortality and proportion at more than 2 persons per room	+0 24	±0 17	1 33	0 1<P< 2
Heart disease mortality and latitude	+0 51	±0 14	3 16	P< 01
Females				
Heart disease mortality and social index	+0 54	±0 13	3 43	P< 01
Heart disease mortality and persons per room	+0 32	±0 16	1 77	0 05<P< 1
Heart disease mortality and proportion at more than 2 persons per room	+0 19	±0 18	1 00	0 3<P< 4
Heart disease mortality and latitude	+0 49	±0 14	2 99	P< 01
Social and Environmental Factors				
Social index and latitude	+0 50	±0 14	3 06	P< 01
Social index and persons per room	+0 61	±0 12	4 07	P< 01
Social index and proportion at more than 2 persons per room	+0 54	±0 13	3 35	P< 01
Latitude and persons per room	+0 44	±0 15	2 59	0 01<P< 02
Latitude and proportion at more than 2 persons per room	+0 52	±0 13	3 23	P< 01
Persons per room and proportion at more than 2 persons per room	+0 94	±0 02	14 94	P< 01

TABLE X

PARTIAL CORRELATION COEFFICIENTS BETWEEN HEART DISEASE MORTALITY IN MALES, 15 TO 34 YEARS, AND SOCIAL AND ENVIRONMENTAL FACTORS IN THIRTY COUNTY BOROUGHS, 1931-33

	Variable held constant	r	Standard error	t	
Heart disease mortality and social index	Persons per room	+0 39	±0 16	2 21	0 02<P< 05
Heart disease mortality and social index	Proportion at more than 2 persons per room	+0 42	±0 15	2 44	0 01<P< 02
Heart disease mortality and social index	Latitude	+0 30	±0 17	1 62	0 1<P< 2
Heart disease mortality and latitude	Social index	+0 36	±0 16	2 01	0 05<P< 1
Heart disease mortality and latitude	Persons per room	+0 45	±0 15	2 59	0 01<P< 02
Heart disease mortality and latitude	Proportion at more than 2 persons per room	+0 47	±0 14	2 74	0 01<P< 02
Heart disease mortality and persons per room	Social index	+0 01	±0 18	0 06	0 3<P
Heart disease mortality and persons per room	Latitude	+0 10	±0 18	0 50	0 3<P
Heart disease mortality and proportion at more than 2 persons per room	Social index	−0 02	±0 18	−0 09	0 3<P
Heart disease mortality and proportion at more than 2 persons per room	Latitude	−0 03	±0 18	−0 18	0 3<P

TABLE XI

PARTIAL CORRELATION COEFFICIENTS BETWEEN HEART DISEASE MORTALITY IN FEMALES, 15 TO 34 YEARS, AND SOCIAL AND ENVIRONMENTAL FACTORS IN THIRTY COUNTY BOROUGHS, 1931-33

	Variable held constant	r	Standard error	t	
Heart disease mortality and social index	Persons per room	+0 47	±0 14	2 73	0 01<P< 02
Heart disease mortality and social index	Proportion at more than 2 persons per room	+0 53	±0 13	3 29	P< 01
Heart disease mortality and social index	Latitude	+0 39	±0 15	2 23	0 02<P< 05
Heart disease mortality and latitude	Social index	+0 30	±0 17	1 64	0 1<P< 2
Heart disease mortality and latitude	Persons per room	+0 41	±0 15	2 36	0 02<P< 05
Heart disease mortality and latitude	Proportion at more than 2 persons per room	+0 47	±0 14	2 77	0 01<P< 02
Heart disease mortality and persons per room	Social index	−0 02	±0 18	−0 11	0 3<P
Heart disease mortality and persons per room	Latitude	+0 13	±0 18	0 68	0 3<P
Heart disease mortality and proportion at more than 2 persons per room	Social index	−0 15	±0 18	−0 78	0 3<P
Heart disease mortality and proportion at more than 2 persons per room	Latitude	−0 09	±0 18	−0 49	0 3<P

TABLE XII

UNWEIGHTED AVERAGE MORTALITY RATE PER MILLION FROM HEART DISEASE, AGES 15 TO 34 YEARS, 1931-33, IN THIRTY COUNTY BOROUGHS GROUPED ACCORDING TO THEIR SOCIAL INDICES AND LATITUDE

	Males			Females		
	Social index			Social index		
	Under 350	350-399	Over 400	Under 350	350-399	Over 400
Latitude S of 52° N	166	218	251	241	261	432
Latitude 52° N -53° 20′ N	212	267	346	270	297	381
Latitude N of 53° 20′ N	290	265	281	352	374	379

similar problems is the absence of a reliable method of accurately measuring such fundamental features as poverty and housing conditions, though there is good reason to suspect their influence Until the indices of social and environmental conditions are improved the true measures of associations must remain undetermined

SUMMARY

An analysis has been made for England and Wales, and its administrative areas, of the mortality at ages 5 to 14, 15 to 24, and 25 to 34 years due to rheumatic fever and heart disease, the preponderance of the latter at these ages being directly attributable to rheumatic fever Between 1921-23 and 1936-38, the period of years covered by this study, the total mortality from rheumatic fever and heart disease shows a substantial decline for both sexes at the school ages 5 to 14 On the other hand, at the ages of adolescence and young adult life, 15 to 34, the fall in mortality has been very slight and disappointing since 1924-26 This trend (measured on heart disease only) is uniformly apparent in the aggregates of each of the broad administrative areas of the country—county boroughs, urban districts, rural districts The County of London reveals a rather divergent experience From a relatively high level in 1920-22 its death rates, particularly at ages 5 to 14 and 15 to 24, have shown a greater degree of improvement than the rest of the country It is not possible to attribute this to the operation of the Special Scheme introduced by the London County Council, since the fall in mortality has been equally great in areas of Greater London outside this Scheme It appears, therefore, to be a local change, not easily explained

In general, mortality increases with the degree of urbanization, the rates for rural areas being appreciably below those of the large towns, and it falls more heavily on girls and young women than on boys and young men The mortality from heart disease at ages 15 to 34 in thirty large towns has been correlated with indices of their social and environmental features No relationship is apparent between mortality and overcrowding, but a moderate degree of association is found between the death rate and the proportion of employed males belonging to the lowest social classes and with the latitude of the city

I wish to thank Prof A Bradford Hill for much helpful advice, and Mrs Young who kindly drew the diagrams

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REVIEW

Population Policy in Great Britain A Report by P E P 1948 Published by P E P (Political and Economic Planning), 16 Queen Anne s Gate, London, S W 1 1948 Pp 228, 24 tables, and 9 charts (Price 15*s*)

The organization known as P E P has earned for itself a sound reputation as a fact-finding body and has produced a considerable number and variety of pamphlets and books which have commanded the respect and gratitude of the social scientists and of all who are interested in the affairs of our society No publication of P E P can claim greater interest or importance than the one now being considered

The public health, the health of the population, the wellbeing of an organized society, can be measured by the use of certain demographic yardsticks Movements of the birthrate, deathrate, natural increase, and fertility rate, are reflections of the reactions of human beings to circumstances and conditions within their external world This book is a comprehensive, fully documented, and simply presented account of population trends in this country associated with a fair, frank, and objective consideration of what these trends mean to us as a people and to our government The book ends with a series of suggestions concerning the policy to be adopted and the actions to be taken if it be decided that it is desirable that the quantity and quality of the British people shall be at least maintained

There is little that is peculiarly new in this book either in respect of factual information or of interpretation, but there is no other book of recent appearance which presents so complete an account of this particular subject, for in it are integrated and synthesized the results of the labours and ponderings of the many who in recent years have written upon it

Emerging from the argument concerning population trends and the retreat from parenthood is the decision that the objective of a population policy in so far as this country is concerned must be to achieve a stable fertility at a level involving an average number of about 2 5 children in each family, which means of course that a considerable number of families must include 4 or 5 children The methods to be adopted for the achievement of this objective are then set out in detail maternity grants, family allowances (which it is suggested should be doubled), social insurance, tax rebates, the provision of suitable houses, and other environmental health services It is clearly recognized that the removal of the economic burdens of parentage are not in themselves sufficient to persuade people to increase the size of their families The main proposal in this Report relates to the new Health Service, from which much is expected It is suggested that to the Minister of Health should be given an additional portfolio of Minister of Population, and that within the National Health Service there should be an organized Family Welfare Service in which the general practitioner of medicine would be the adviser of those about to marry and the guardian of the child yet to be conceived

There is no doubt that for the present the recommendations made in this Report are far in advance of public opinion and of the ability on the part of the profession of medicine to give effect to them The Report is strongly to be recommended, however, to all who are directly or indirectly concerned with the maintenance and augmentation of the health of the people, especially to such as are concerned with programmes of planned migration and of the relief of manpower shortage in this country by the importation of displaced persons It should be regarded as an argument in favour of the institution of a positive population policy and the reader should continuously attempt to refute its arguments although not of course by the reiteration of some peculiar and precious prejudice The open minded, if there be such, will find it difficult to reach conclusions markedly different from those which this book presents

F A E Crew

ABSTRACTS

(This section of the JOURNAL *is devoted to selected abstracts of articles on social medicine appearing in the current literature The section will be edited in collaboration with the two abstracting Journals,* Abstracts of World Medicine, *and* Abstracts of Surgery, Obstetrics and Gynaecology)

Statistics of Stillbirth and Early Neonatal Death (Statistiques de mortinatalité et de mortalite precoce (Année 1947)) LÉVY-SOLAL, M , and LAUTMANN, — (1948) *Gynec et Obstet* , 47, 302

The authors present the 1947 statistics of neonatal death and death in early infancy for the Baudelocque Maternity Hospital, Paris They refer to 3,687 births, 83 (2 27 per cent) babies were macerated or stillborn, and 35 (0 97 per cent) died in the first 12 days It is specified that no child weighing under 2,500 g is discharged from the hospital, 255 of those born alive were under this weight

There still is no general agreement in France as regards the definition of stillbirth and early neonatal mortality, that is, death in the first 72 hours of infancy An international ruling would be welcome Neither is there a specific definition of the term " debility " (immaturity), weight still being the main criterion for this condition, although certain infants of under 2,500 g weight appear healthy and vigorous, while others seem hypotonic and are difficult to rear Mortality in the first 12 days (35 cases) was due to obstetric trauma (6), malformations (7), immaturity (14), toxicosis or diarrhoea (3), Rh-incompatibility (2), and various other causes (3) Of these children, 26 weighed less than 2,500 g The importance of otitis media is stressed The rare cases of pulmonary oedema quickly responded to oxygen and penicillin therapy

Comparing their 2 27 per cent stillbirth rate with figures for previous years, the authors believe that improvement has been considerable, because of progress in prophylaxis and treatment of syphilis, pregnancy toxaemias, disproportion, heart affections, and tuberculosis, and also because of better obstetric technique (caesarean section, resuscitation) Immature infants are isolated in special wards where they receive the classical treatment under special supervision It is especially in improvement of care of these infants that, in the authors' opinion, better results can be obtained *H Godar*

Children's Hostels in War and Peace. WINNICOTT, D W (1948) *Brit J med Psychol* , 21, 175

A plea is made for the retention of hostels for difficult children in peace time, especially if the children can be under the direction of the psychiatrist who sees them in the clinics Little new in psychological theory came out of evacuation experience, but a large number of people became aware both of the existence of, and reasons for, antisocial behaviour of children Two broad categories of children require in peace time to be sent to hostels with specially trained staff (1) those whose homes do not exist, (2) those whose parents cannot form a stable background in which the child can develop, and those with an existing home which contains a mentally ill parent It is essential that the staff of hostels should be supported and advised by the psychiatrist and psychiatric social worker In fact the staff may need more attention than the children for if the latter are properly placed and cared for in the right psychological environment little other treatment may be needed Individual psychotherapy may be needed, but it is noticeable that the better the warden or the parent the more the intrusion of the psychotherapist will be resisted or even resented Such work is definitely prophylactic in the interests of the Home Office, whose function it is to prevent crime

Sixteen case notes are appended as illustration, the wholesale closing down of war time hostels is deplored Attention is drawn to the fact that practically no accommodation is available for psychotic children " Officially they do not exist " *R G Gordon*

The First Ten Years of Rheumatic Infection in Childhood. ASH, R. (1948) *Amer Heart J* , 36, 89

The author analyses a follow-up study of 547 children observed for 10 years after the onset of rheumatic fever At the end of the 10-year period over 90 per cent of the group had been located At the end of the initial attack 41 per cent gave no evidence of heart disease, of these over 76 still showed no evidence of heart disease at the end of 10 years, while only 5 per cent had died of rheumatic infection or bacterial endocarditis Of those children with rheumatic heart disease in the initial attack, over 40 per cent had died by the end of 10 years of rheumatic infection or bacterial endocarditis, while in just under 10 per cent the signs of cardiac involvement had disappeared

The results agree closely with the larger group reported earlier by Jones and Bland (*Trans Ass Amer Phys* , 1942, 57, 265) *R J Grant*

Social Conflict and the Challenge to Psychology MONEY-KYRLE, R E (1948) *Brit J med Psychol* , 21, 215

Psychologists have recently claimed that world problems are psychological as well as economic Now that economic theories have not proved very successful, psychologists are being challenged to make good their claims The difficulty of this lies in the difference of attitude between science and ethics Science is neutral in its attitude and may therefore be evasive ethics are partisan While in individual mental health the environment is important, the underlying motives are really more important So in social health a study of motives may also be significant and the promotion of this study may be the contribution of psychology to social sciences A non-partisan approach to the study of motives will show how society tends to divide everything into white and black, into good and bad, and how the guilt of one side is projected into the bad (opposing) party or nation Even people who are normally both modest and charitable in private life and easily forgive their enemies find it much harder to criticize the party or nation with which they identify themselves and may be implacable in their moral condemnation of its opponents Those who are unable to admit any share of blame are never able to forgive their enemies and those who are never forgiven find it still more difficult to become conscious of their guilt Thus the denial and projection of guilt is one of the main factors in national and political vindictiveness and so tends to the perpetuation of all feuds and to political callousness and tyranny Rapid progress cannot be expected in changing the viewpoint of individuals, but gradually more and more people may be got to think in this way *R G Gordon*

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CONTENTS

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THE BRITISH JOURNAL OF SOCIAL MEDICINE is intended for the publication of original work in the field, although not necessarily by authors of British nationality

As understood by those who are responsible for this Journal social medicine is that branch of science which is concerned with (*a*) biological needs, interactions, disabilities, and potentialities of human beings living in social aggregates, (*b*) numerical, structural, and functional changes of human populations in their biological and medical aspects To a large extent its methods must necessarily be statistical, involving the use of numerical data obtained either from official sources or from special field investigations, and interpreted in the light of established findings of the laboratory and of the clinic. Social medicine takes within its province the study of all environmental agencies, living and non-living, relevant to health and efficiency, also fertility and population genetics, norms and ranges of variation with respect to individual differences and, finally, investigations directed to the assessment of a regimen of positive health Such being the definition and scope of social medicine as understood by the editors, it follows that this Journal is not meant to provide a platform for those who wish to present their views concerning the place of social medicine in the organizational set-up of medicine as a whole

The scope of the Journal and, therefore, the content of social medicine will be illustrated by the nature and diversity of the papers that go to the make-up of the first few numbers These will also show that the territory claimed by social medicine is not adequately covered by journals that serve the interests of the specialists in such allied subjects as public health and preventive medicine, biometrics, eugenics, and the social sciences

So far as is possible in these difficult days, this Journal will be published quarterly

All papers submitted for publication and all other editorial matters should be addressed to one of the editors

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Buzzard, Farquhar (1943) *Practitioner*, **151**, 129

Grotjahn, A (1923) *Soziale Pathologie*, 3rd edit., Springer, Berlin.

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MILK-BORNE INFECTIONS IN GREAT BRITAIN

BY

SIR WILLIAM SAVAGE

As long ago as 1857 Dr Taylor of Penrith showed that an outbreak of typhoid fever was spread by milk Since that date the literature has been strewn with reports on milk-spread outbreaks of infectious disease, but even so numerous outbreaks remain unrecorded

The importance of milk as a vehicle for the transmission of disease is due to three factors The cow may suffer from infections which are common also to man, milk is a suitable medium for the multiplication of most pathogenic organisms and ingestion is an important factor in infection, milk is much handled between cow and consumer, so facilitating its infection

There are three sources of human milk-spread infections (1) Bovine infection of the cow may cause tuberculosis, brucellosis, some salmonella infections, and, very rarely, foot and mouth disease and anthrax (2) Through the cow, but in the animal due to human bacterial strains implanted from human sources, some scarlet fever and other streptococcal infections and certain staphylococcal infections are so disseminated (3) Specific contamination of the milk after it leaves the cow may be the cause of the enteric infections, i e typhoid fever, paratyphoid fever and dysentery, diphtheria, some scarlet fever and other streptococcal infections, most staphylococcal infections, and some salmonella outbreaks

Although it is possible to estimate with considerable accuracy the extent to which tuberculosis in man is of bovine origin and to make an estimate of human brucellosis, we are without reliable statistics of the extent of other infections

The Ministry of Health list of milk-borne outbreaks of infection reported in Great Britain between 1900 and 1933 and tabulated by the Committee on Cattle Diseases includes 97 outbreaks, analysed as enteric fever 30, paratyphoid fever 7, typhoid and dysentery 4, diphtheria 14, scarlet fever 28, sore throat 5, gastro-enteritis 3, salmonella 3, sickness and diarrhoea 3 G S Wilson in *The Pasteurization of Milk* mentions 69 outbreaks in the years 1912-37 comprising scarlet fever and septic sore throat 40, diphtheria 20 the three enteric diseases 39, gastro-enteritis 14, total 113 Both authorities stress the marked incompleteness of the records The comparative prevalence today of these infections can be judged from the following list of 25 outbreaks over the last seven years collected by the author without any detailed study of the literature They are (excluding tuberculosis) undulant fever 2, scarlet fever 2, diphtheria 1, typhoid fever 2, paratyphoid fever 4, dysentery 11 (Sonne type 9, other types 2), salmonella Dublin 2, staphylococcus food poisoning 1 Many outbreaks are never recorded in the literature or only obtain brief mention in not readily accessible annual reports of medical officers of health It is probably a decided understatement to write that well over 50 per cent of definite outbreaks are never recorded in available literature

TUBERCULOSIS

This in man is the most important disease derived from the cow Its incidence in human beings depends upon its prevalence in bovines, and the problem of its control is associated with the distribution of tuberculosis in bovines and particularly in cows

No complete figures are available of the extent of bovine tuberculosis in Great Britain, but three sources of information have been utilized One, that of animals killed under the Tuberculosis Order, 1913, is very unreliable and much affected by the extent to which the Order is enforced It merely supplies corroborative evidence The results of abattoir findings as to the number of animals found tuberculous on slaughter are a valuable guide, but are somewhat selective, as those slaughtered include an undue percentage of older animals and also many of poor quality

The only reliable index of the extent of bovine tuberculosis is from the results of systematic testing of cows and cattle with tuberculin This does supply accurate figures as to the number of infected animals but this method neither measures the extent of the infection nor the degree of infectivity to man Unfortunately such findings are only available for selected herds, mainly in connexion with the attested herds scheme or for the formation of tuberculin tested herds This involves a considerable selection of herds, since those anticipated to

have a low incidence of tuberculosis are more liable to be selected Again, the figures are usually given for cattle and not for dairy cows, the essential item from the human standpoint These limitations must be borne in mind in assessing the results, but the findings are of great value Ritchie and Stamp (1948) report that up to the end of October, 1947, 29,552 herds comprising 1,171,822 cattle have qualified for the attested herds register This represents 13 4 per cent of the cattle in Great Britain, i e in Scotland 30 1 per cent., Wales 24 5 per cent, England 7 9 per cent. When the results are distributed into counties they show very wide variations in incidence Francis (1947) in his valuable book, *Bovine Tuberculosis*, gives the figures for each county for cattle (not cows) using the survey figures for 1938 For English counties those with percentages under 10 include Cumberland (7 0), Devon (5 6), Durham (4 5), Yorkshire (7 2–9 3), Hereford (5 1), over 30 per cent positive were found in Cheshire (41 6), Derbyshire (32 2), Kent (37 0), and Nottinghamshire (31 2) Welsh counties ranged from 1 8 to 49 6 per cent and Scottish counties from 2 6 to 66 3 These figures give the percentages for England as 14 1 for Wales 4 1, and for Scotland 13 0

Abattoir figures are, in general, in accord with these findings The *Veterinary Record* (1948) in an unsigned article gives an interesting series of maps showing the relative incidence in each county based upon this survey and other data

Ritchie (1948) has made a more recent (1945) estimate and considers the incidence of " reactors," i e those positive to tuberculin tests, in cattle in England to be about 20 per cent, with 17-18 per cent for Great Britain He considers that this represents 30 to 35 per cent of infection among cows

These figures show that the incidence of tuberculosis in cows in Great Britain is very high and varies markedly from county to county Also it may vary widely within the one county For example Wilson (1937) in Herefordshire found percentages of 5 to 60 in different districts The considerable number of herds freed from tuberculosis naturally reduces the percentage of "reactors" but as yet the proportion to the total cow population is too small to affect materially the overall figure Allowing for the selective nature of these testings, it can be stated reliably that today about 35 per cent of dairy cows are affected with tuberculosis in Great Britain This is a reduction on the figure of 40 per cent widely accepted for conditions existing a decade or so ago and is caused by the material progress being made in eradication

All reactor cows are potential spreaders of tuberculosis to other animals, but their liability to be excretors of tubercle bacilli into the milk essentially depends upon the organs affected with tuberculosis Tuberculosis of the udder is undoubtedly responsible for the heaviest infection of milk with tubercle bacilli Savage in 1929 discussed the incidence and concluded that most of the figures advanced were too high, and estimated clinically detectable udder tuberculosis as 0 2 to 0 3 per cent in unselected herds with a figure probably twice as high if all lesions demonstrable by pathological examination were included The figures of Torrance (1936-37) support this estimate, as out of a cow population of 24,500 the use of biological tests, clinical examination, and pathological post-mortem examinations yielded 0 59 per cent of udder tuberculosis With 35 per cent of reactors this figure suggests that 1 7 per cent of all reactors suffer from tuberculosis of the udder and are especially liable to spread infection to man Tubercle bacilli may get into the milk from tuberculous cows without udder lesions, as Griffith and Griffith (1911) demonstrated to the Royal Commission on Tuberculosis, but this is rare, also tubercle bacilli are excreted in dung, particularly from cows with intestinal tuberculosis, and so may get into the milk supply Stamp (1943) gives a good account of the pathological lesions in udder tuberculosis and evidence of tubercular foci not visible to the naked eye

The varied incidence of tuberculosis in dairy cattle in different parts of the country is reflected in a wide range of findings of tubercle bacilli in milk Percentages ranging from 3 to 15 or even higher are recorded When bulked milk is examined the percentage is very high, usually 80 to 100 For example, in Somerset milk samples collected from undesignated individual herds show over a period of 15 years ending in 1948 a percentage positive always between 2 0 and 3 0 except for 1940 and 1941 when they were 4 4 and 4 3

One of the most comprehensive investigations was undertaken in Scotland (1933) The positive incidence in raw milk in churns for the four main cities was roughly 10 per cent, with Glasgow highest (13 4 per cent) and Dundee lowest (6 6 per cent.) The incidence of infection increased with the volume of milk from which the sample was collected Untreated retailed milk in the same four towns was 11 76 per cent positive Raw milk transported in tanks was 37 5 per cent positive

The proportion of human tuberculosis of bovine origin was largely guess work until bacteriologists were able to differentiate the type of tubercle bacillus

TABLE I

ANALYSIS OF DEATHS DUE TO BOVINE TUBERCULOSIS IN THE YEAR 1931

Type of Tuberculosis	Deaths under 5 years	Percentage Bovine	Calculated Deaths of Bovine Origin	Deaths over 5 years	Percentage Bovine	Calculated Deaths of Bovine Origin	All Ages Calculated Bovine Deaths
Respiratory	303	0	0	27,355	1	294	294
Nervous	1,286	34	437	1,312	20	262	699
Abdominal	291	80	235	235	33	267	502
Generalized	327	25	82	971	9	87	169
Other varieties	55	20	11	1,115	5	56	67
All kinds	2,262	33	765	33,553	2 9	966	1,731

present in individual human cases When a sufficient number of examinations of suitable material was available it was possible to determine with considerable accuracy the proportion of human tuberculosis due to the bovine tubercle bacillus Savage (1929), using the official statistics of deaths from each variety of tuberculosis first made this calculation in 1927 A special tuberculosis committee of the People's League of Health reinvestigated the problem in 1931 and produced very similar figures Savage brought his figures up to date in his Mitchell Lecture (1933) and Table I is taken from that lecture

This and similar estimates have been accepted by all authorities but it is important to consider how far they are reasonably accurate for 1948 On the one hand tuberculosis as a whole has shown a steady decline, apart from a temporary war increase We do not know whether that small proportion due to the bovine bacillus has declined proportionately, but in view of the great increase in the heat-treatment of milk in our large towns a considerable decline is likely to have resulted On the other hand, in Table I there is one considerable miscalculation brought out by recent investigations Over recent years much evidence has been adduced that the percentage of bovine infections in respiratory tuberculosis is much higher than was originally accepted This is particularly the case in Scotland where Munro (1939) found 50 cases of bovine infections out of 1 061 respiratory tuberculosis cases, a percentage of 4 7, at Glenlomond Sanatorium, and quotes Griffith s findings at two other Scottish sanatoria of 24 bovine out of 534 cases, a percentage of 4 5 Cutbill and Lynn (1944) in Cheshire found 48 bovine infections in 2,101 pulmonary tuberculosis cases, collected over a period of 15 years a percentage of 2 3

In their most recent paper Griffith and Munro (1944) have summarized the figures up to 1944 including their own work and that of Cumming, Lynn and Cutbill, Paget, and others These are set out briefly in Table II

The respiratory tuberculosis cases of bovine origin were distributed unequally in the different regions and, in general, with gradually decreasing frequency from the north of Scotland to the south of England

Lange (1932) of Berlin took the view that most of these pulmonary cases associated with the bovine strain were attributable to infection in connexion with their employment Undoubtedly some of the infections occur in this way as direct infections from tuberculous cattle, but Griffith and Munro found that for the great majority of the cases the alimentary canal was the portal of entry with infected milk as the probable source of infection A very few cases were due to infection from a human case infected with the bovine tubercle bacillus

Human pulmonary tuberculosis due to the bovine bacillus is met with in other countries For example Knudsen (1947) in Denmark, out of 113 cases isolated 13 (11 5 per cent) of bovine type, and Ruys in the Netherlands obtained high figures (see Table V)

For calculation purposes it is safe to assume that at least 2 per cent of cases of respiratory tuberculosis are due to the bovine bacillus This would add 294 deaths to Table I, increasing the total estimated

TABLE II

INCIDENCE OF BOVINE TUBERCULOSIS

Country	No of Cases Investigated	Cases due to Bovine Bacillus	Percentage Bovine
Scotland	2 769	160	5 7
England, Wales Eire	4 194	81	1 9

deaths to 2,025 Allowing for the undoubted decline in incidence, about 1,500 deaths a year would be a reasonable estimate for the present time To these must be added the several thousand cases a year due to bovine infections not resulting in death

The higher incidence of tuberculosis, in all its forms, of bovine origin in Scotland is well known, but recent work has shown a definite relationship in incidence between town and country A few examples may be quoted

Lethem (1946), selecting abdominal tuberculosis in children under five years as usually due to the bovine strain, gives the following figures (Table III)

TABLE III

COMPARISON OF INCIDENCE BETWEEN TOWN AND COUNTRY

Area	Death Rate per Million			
	1921	1930	1938	1944
London Administrative County	136	24	12	6
Combined county boroughs	437	157	63	35
Combined urban districts	366	134	77	42
Combined rural districts	252	92	63	60

This table illustrates the much higher rates in rural districts, as well as the striking reductions since 1921 By 1930 the proportion of heat-treated milk in the Administrative County of London had risen to about 90 per cent, whereas in 1939 it was 98 per cent, the corresponding figures in county boroughs being 35 per cent and 60 per cent

Blacklock (1947), as the result of detailed bacteriological and pathological examinations of children under 13 years infected with the tubercle bacillus found the bovine percentages to be primary lung lesions 3 6, abdominal 80 8 (1914-32) and 64 7 (1943-44), cervical glands 70 2 (1914-35) and 67 5 (1943-44)

The distribution figures are interesting

TABLE IV

DISTRIBUTION

Area	Tuberculous Meningitis (% Bovine)	Surgical Tuberculosis (% Bovine)	Heat-treatment of Milk Supply
Glasgow	2 3	8 8	95% heat-treated
Large boroughs in the Clyde Valley	8 2	13 6	Considerable but much less than in Glasgow
Rural areas in the western counties	10 9	44 4	Practically no heat-treatment

Cervical adenitis cases of bovine origin were 77 2 per cent bovine in country areas compared with 46 8 per cent in urban areas

Price (1938) in Canada examined a series of 500 tuberculous children under 14 years of age over a period of 13 years Of these, 9 per cent of cases of extra-pulmonary tuberculosis were of bovine origin None of the cases derived from Toronto, a large city with 100 per cent pasteurization of milk All the cases of bovine infection came from Ontario outside Toronto, and the history invariably revealed that the child had been fed with raw milk From 200 samples of raw milk coming into the city to be pasteurized, 26 per cent yielded living tubercle bacilli

Ruys (1939), including her own findings and those from other Dutch investigators, gives the following figures for 1933-38

Here the difference between town and country is present but not marked, for it was only since 1940 that pasteurization was extensively used in Amsterdam and elsewhere For 1933-39 the bovine

TABLE V

INCIDENCE OF BOVINE TUBERCULOSIS IN THE NETHERLANDS (1933-38)

	Pulmonary Tuberculosis				All Other Forms of Tuberculosis			
	All Ages		0-15 years		All Ages		0-15 years	
	No Examined	Bovine (%)	No Examined	Bovine (%)	No Examined	Bovine (%)	No Examined	Bovine (%)
Towns over 100,000	699	4 3	282	9 2	229	20 5	71	21 1
Rest of the country	619	6 8	116	9 4	260	25 4	41	43 9

percentage for pulmonary tuberculosis in Amsterdam was 9 6, for 1940-44 only 1 8, with a corresponding decline for other types

Greater London, Scotland, Canada, the Netherlands, all yield the same picture of a striking reduction of bovine infection with the increased ratio of pasteurized to unpasteurized milk

Tuberculosis of bovine origin is becoming mainly a rural and small urban district problem

Brucellosis in Man (Undulant Fever)

Of the three brucella types *Br melitensis*, *Br abortus* and *Br suis*, the only one which affects dairy cattle in Great Britain is the *abortus* strain, and this is the cause of contagious abortion in cows and of undulant fever in man Human infections in Great Britain with the other two strains are rare indeed They occasionally occur in cows, and Duke (1940) in a bulk sample from an accredited herd of 76 cows isolated *Br melitensis* and subsequently from three of the cows No goats were kept on the farm *Br suis* seems to be rather more prevalent in the U S A Jordan, Borts *et al* (1943) describe an outbreak of human brucellosis of 77 cases in Marcus (Iowa) due to *Br suis* and mention an earlier outbreak in 1933 due to the same type In Iowa, a cattle and hog raising state, the official notification rate of human brucellosis over a 12-year period was 6 25 per 100,000

Contagious abortion is widely prevalent in Great Britain and its extent can be judged from examinations of milk These show that some 20 to 30 per cent of herd milk samples contain living *Br abortus* organisms but the percentage varies widely in different districts as shown by the following examples Pullinger (1934) found 37 per cent of mixed milk from single farms positive in Cheshire and only 19 per cent positive in Somerset Priestley (1934) using positive agglutination reactions as criteria records variable figures, but not less than 20 per cent of cows showed antibodies specific to *Br abortus* in their blood Smith (1934) in the Aberdeen area examined samples of milk from 183 single cows and 17 (9 2 per cent) yielded *Br abortus* Menton (1940) examined over 1,000 milk samples from the Midlands and 34 5 per cent showed positive agglutinins, but living *Br abortus* was only isolated from 29 1 per cent, whereas a further 9 1 per cent of samples contained *Br abortus* but were devoid of agglutinins Jones (1943) examined 314 samples of milk in the Liverpool area (1933-34) and 15 3 per cent contained *Br abortus* whereas of 408 samples from Kent 14 5 per cent were positive

The number of cases each year of undulant fever is not known, as many cases are not diagnosed while the disease is not a notifiable one, but it is possible to give an estimate The most reliable basis is from large-scale serum agglutination testings These have not been carried out systematically, particularly in rural areas where a higher incidence may be anticipated Of 3,175 sera examined from various sources 101 were positive, a percentage of 3 18, which corresponds to 440 new cases a year (Topley and Wilson, 1946) In addition there are many cases of latent infection, with positive serum agglutination below the significant figure of 1 80+, infections associated with the comparatively low pathogenicity of *Br abortus* to man Wilson's (1932) estimate of about 500 new cases a year is probably near the mark

Dalrymple-Champneys (1948) has collected records of some 900 cases of undulant fever and his paper gives a good account of its epidemiology The case mortality in his series was only 2 3 per cent, but the disease often causes prolonged incapacity The majority of recorded cases are single infections but a number of small outbreaks have been recorded in schools, such as those described by Elkington *et al* (1940), by Cruickshank and Stevenson (1942), and the small outbreak of four cases at a school at North Molton (1942)

The discrepancy between the high incidence of contagious abortion in cows and the comparatively few cases of undulant fever in man is partly accounted for by the probability of numerous minimal infections with no definite symptoms but causing immunity, and partly to the low virulence of *Br abortus* to man

Although human infection is usually due to the consumption of infected raw milk an unknown proportion is spread by direct contact with infected animals amongst farm workers, veterinary surgeons, and men engaged in animal slaughtering Smith (1934) examined the sera of 106 men associated with meat and slaughtering He found 16 1 per cent of sera from slaughtermen and 10 5 per cent of sera from men working in allied trades agglutinated *Br abortus* 1 25 or more, compared with 6 8 per cent from unselected cases There was no incidence of undulant fever but some evidence of latent infections This is in accord with other studies, but some investigators consider a material proportion of cases are contact infections

Streptococcal Infections

These outbreaks fall into two of the three groups mentioned at the beginning of this paper, namely that due to infection of the milk from human strains implanted in the udder of the cow or to specific

contamination of the milk after it leaves the cow The human diseases are outbreaks of septic sore throat, scarlet fever and, very rarely, streptococcal food poisoning

Mastitis is a prevalent disease in cows, but the organism mainly responsible is *Str agalactiae* and this type is harmless to man, as Savage (1911) demonstrated in 1906-11 He further showed that when a cow with mastitis is responsible for a human outbreak of sore throat it is because the udder has been invaded and infected with a *Str pyogenes* strain of human origin This view is now fully accepted and, using the typing methods of Lancefield and Griffith, it can be regularly demonstrated

The bovine types, including *Str agalactiae*, may or may not be haemolytic but are nearly all Type B Isaac and Nussbaum (1940), for example, examined 93 milk samples for haemolytic streptococci *Type A strains* were absent and *Type B* were over 80 per cent The pathogenic strains are about 90 per cent Type A and this type includes all those responsible for sore throat outbreaks They belong, however, to a number of *Griffith types*

These pathogenic streptococci do not readily establish themselves in the bovine udder, but this is facilitated if there are udder or teat lesions This accounts for the comparative rarity of such outbreaks in Great Britain, although they seem to be more prevalent in the U S A Examples of widespread outbreaks are the Colchester outbreak in 1905 with over 600 cases and the Hove-Brighton outbreak of 1929-30 with more than 1,000 cases and over 60 deaths

Until the last *30 years* or so, *milk*-spread outbreaks of scarlet fever were ascribed to direct infection of the milk from a case or carrier Although this is the method of spread in some instances, the evidence strongly suggests that the majority are due to udder infection with the pathogenic streptococcus, exactly as for sore throat outbreaks The evidence is along four lines

Various investigators have shown that *Str pyogenes* strains grow with difficulty and slowly in ordinary milk Jones demonstrated this as early as 1928 and ascribed it to a definite inhibitory substance in milk destroyed when milk is boiled Davis (1914) showed the same finding for milk at 26° C using a strain directly isolated from a sore throat outbreak at Chicago and confirmed that with sterile milk considerable multiplication occurred Pullinger and Kemp (1937) found similar failure to multiply at 18-20° C in unsterilized milk and also that the initial degree of contamination with *Str pyogenes* had no influence upon their inability to multiply

Epidemiologically it is difficult to account for scarlet fever outbreaks which have a considerable duration unless there is some nidus which continues to infect the milk

In most recent outbreaks the cases consist of a mixture of clinical scarlet fever with rash and sore throat and those without rash so we should expect causation to be similar to outbreaks of infective sore throat and the relationship of these outbreaks to infected cows is proved to the hilt

In many of the more recent scarlet fever outbreaks it has been possible to prove the association of the outbreak with a cow with an udder infected with a streptococcus of the same type as the human case

The 1936 Doncaster (Watson, 1937) outbreak was a mixture of 135 sore throat cases with rash (scarlet fever) and 229 similar cases without rash, and it was spread over 11 days The source of infection was a cow with an indurated teat excreting the same streptococcus Type 2, as was recovered from the patients The 1939 Elgin (Douglas *et al*, 1942) outbreak with 214 cases, some with, some without rash, was due to a Type 3 strain recovered both from patients and the infected cow The earlier Chelmsford (Camps and Wood, 1936) outbreak of 1935 had the same clinical features and was due to Type 2 It lasted 11 days only and probably had the same causation but was not proved, as unfortunately only one cow was bacteriologically investigated

Benedixen and Minett (1938) kept the Doncaster infected cow and a cow responsible for a similar outbreak at Morkov (Denmark) under observation The Danish cow continued to excrete the *Str pyogenes* strain from the affected quarter for at least 13 months and the Doncaster cow for about six weeks

In the U S A this association with bovine infection is more widely recognized Dublin *et al* (1943) record that there were 57 outbreaks of scarlet fever and sore throat in New York (excluding New York City) The strain was typed in some outbreaks and three were Type 3, one Type 2, and the rest other types The majority were associated with an infected udder

There is no evidence that the type of clinical case has any relationship to the streptococcus type, although Evans (1946) from a study of 23 such strains suggests that this is so

So far it has been a rare occurrence, but severe septic infection may be the *essential feature* as in the interesting little outbreak described by Golledge (1932) with four cases of whom two died They were infected from two cows suffering from mastitis, and the strain recovered from cows and patients was *Str pyogenes* Type I

When outbreaks result from direct infection of the milk, without cow intervention, they are usually explosive and limited in duration The mixed scarlet fever and sore throat outbreak at Vejle in 1937 (Henningsen and Ernst, 1939) is a good example About two-thirds of the cases were spread over four days, and the authors think that infection of the milk may have been confined to a single day No evidence of cow infection was found, but the source was a milkmaid with purulent otitis media following unrecognized scarlet fever Both from her and from many other cases *Str pyogenes* Group A Type 3 was recovered

Enteric Infections

Typhoid fever is usually water-borne, but sometimes the actual vehicle is milk contaminated with water containing typhoid bacilli used for washing utensils or for other purposes Most milk-spread outbreaks are, however, due to direct infection of milk from a milk handler who is either an acute case or, more frequently, a chronic carrier

Milk-spread typhoid outbreaks may be very extensive, such as the 1936 outbreak in Bournemouth and Poole (Shaw, 1937) This outbreak attacked at least 718 persons and caused about 70 deaths, it is also interesting since it was suggested that infection might have been transmitted through dung following systematic infection of a cow from drinking contaminated water No evidence in support was adduced and direct experiments by Scott and Minett (1947) with a cow fed with virulent typhoid bacilli were entirely negative

Improved methods for the isolation of *B typhosus* and new methods which divide the bacillus in types have shown how wide may be the ramifications of milk-spread typhoid fever and also that comparatively few persons may be infected Bradley (1943) supplies a particularly interesting illustration of 21 typhoid cases spread over two years (1941-42) and located in four different counties This involved many milk distributors, and all the cases were traced to a typhoid carrier who infected the milk on a farm in Wiltshire 100 miles away This carrier and all the cases were infected with the rather rare D4 type

The important fact that these milk-spread outbreaks are by no means either always explosive in character or extensive is well illustrated by the little outbreak at Sedgley reported by Bekenn and Edwards (1944) Over a period of 10 months there were six apparently disconnected cases of typhoid fever, but all milk-spread and traced to one farm where an old woman of 78 years was a chronic typhoid carrier

Paratyphoid fever is rarely water-spread but milk is a common vehicle In a study of 40 recent outbreaks Savage (1942) records that eight were milk-spread, whereas 16 were from cream, fresh or mostly artificial, or cream cakes The source of infection of the milk is a temporary or chronic paratyphoid bacillus carrier

There is no doubt that not only have single cases and outbreaks of dysentery been more numerous in recent years but there has been a proportionate increase in those milk-spread Their severity mainly depends upon the dysentery strain responsible Those due to the Flexner type are often extensive and severe with a high mortality as in the Aberdeen (Kinloch, 1923) outbreak of 1919 with over 1,000 cases and 72 deaths The most frequent causative strain in recent outbreaks has been the Sonne type, usually with a very low mortality Outbreaks recorded over the past seven years, due to the Sonne type, are set out in Table VI Frequently it was not possible to ascertain the exact source of infection

Dysentery bacilli do not appear to grow easily or even to survive in raw milk, but Steuer (1941) records periods of survival of from one to 15 days at room temperature

TABLE VI

Analysis of Outbreaks of Dysentery (Sonne Type) over Seven Years

Year	Place	No of Cases	Deaths	Authors of Report
1942	Cardiff	27	0	Hobbs and Allison
1942	Cumberland	43	0	Faulds
1942	Penrith	178—	0	Faulds
1943	Silloth	124	0	Faulds
1944	Dorset	57	0	O Keefe and Cooper
1945	Cheeping Wycombe	76	0	Muir and Vollum
1945	N E Scotland	250	0	Rae and Smith
1947	Scotland	84—	0	Henderson Michie Rae and Smith

Diphtheria

Diphtheria outbreaks spread through milk are comparatively infrequent nevertheless, as shown in the figures given, there have been a good many of them The milk itself is directly infected from an actual case or a carrier of diphtheria bacilli, and usually such a person has been a milker In some of the recent outbreaks, such as the East Yorkshire outbreak of 1941 described by Goldie and Maddock (1943), it has been possible to isolate *C diphtheriae* from the infected milk This outbreak is interesting for the small number of cases compared with those at risk This has occurred in some other outbreaks and the factor of dilution is important

An interesting feature in a few outbreaks has been the association of the human cases with sores shown to be infected with diphtheria bacilli on the teats of some of the cows This was first noted by Dean and Todd in 1902 and later instances are recorded by Ashby (1906), Robertson (1911), Macdonald (1913), and McSweeney and Morgan in 1928 They are surface infections and the bacilli do not invade the udder structure Their possible occurrence is of epidemiological importance, since they may be responsible for prolonging infection and may explain continuance of cases without any explosive outbreak

It is doubtful if diphtheria bacilli multiply readily in raw mixed milk In a few experiments made by Goldie and Maddock (1943) the bacilli remained about the same number for four to six hours at room temperature but then gradually diminished

Food Poisoning

Milk may be the vehicle for two varieties of food poisoning, i e the staphylococcus toxin type and that due to Salmonella organisms

Staphylococcus Food Poisoning—Only a small minority of staphylococcus strains produce the special toxin (enterotoxin) which is responsible for symptoms of food poisoning All are coagulase-positive, most are of *aureus* type, but only a proportion of strains with these properties produce enterotoxin and so cause food poisoning

Many foods can act as a vehicle and milk is not a very common one, although it was responsible for the first recorded outbreak of this nature A human carrier is the common source of infection but the possibility of staphylococci from the cow s udder being a source has been a good deal discussed Staphylococci are fairly common in milk drawn direct from the cow s udder, healthy or diseased . Minett (1938) isolated 38 strains of *Staph aureus* from the bovine udder, seven being from cows with acute mastitis, eight with chronic mastitis, and the rest from cows with normal udders Enterotoxin was reported, having been demonstrated with four, five, and seven strains respectively from these three sources This was based on the so-called "kitten test," but results were negative or very indefinite when feeding experiments were conducted with human volunteers Dolman (1941 and 1943), who has done so much valuable work on this variety of food poisoning, considers that endogenous infection of milk is an important source of infection Out of 74 samples of raw milk examined he claims that 64 contained toxigenic staphylococci The difficulty of accepting these findings is that they are based upon the "kitten intraperitoneal test" which has been severely criticized as unreliable The only completely satisfactory test is human feeding experiments and these have not been used The evidence suggests that only exceptional strains from milk produce enterotoxin and that this is not a common source of infection

An important fact in these outbreaks, with any food as a vehicle, is the significance of the time-temperature factor after infection to allow sufficient enterotoxin to be produced to set up food poisoning

Salmonella Food Poisoning—Outbreaks of this type are not infrequent, either from the direct consumption of milk, or of its products They may be extensive and are explosive in character Of earlier outbreaks may be mentioned Newcastle upon-Tyne (1913), 523 cases, 0 deaths, Withnell and Chorley (1914), 317 cases, 2 deaths, Newcastle under-Lyme (1914), 468 cases, 2 deaths, Glasgow (1914), 370 cases, 0 deaths, Aberdeen (1925), 497 cases, 1 death It is noticeable that in these milk-spread outbreaks the mortality is conspicuously low

For most of these outbreaks the source of infection was a diseased cow For instance, in the 1925 Aberdeen outbreak infection was traced back to a cow with an indurated udder, which developed septicaemia from whom *Sal enteritidis* was isolated from udder and flesh The outbreak of 1947 from the same area was also traced to a cow which died from *Sal enteritidis dublin*, and this strain was isolated from all organs Probably most of these outbreaks were due to the Dublin sub-variety but the differentiation was unknown for the earlier outbreaks The very considerable extent to which *Sal enteritidis dublin* is a cause of bovine infections has been only fully recognized in recent years and merits serious recognition Boswell and Lovell as early as 1931 described three outbreaks in calves due to *Sal dublin* Craig Davies, and Massey (1941) showed that this strain was responsible for a number of cases in a herd in Cheshire, the cases

cropping up over a number of years They found no carrier cases John (1946) gives particulars of four cases and found that all the cows that recovered became carriers and continued to excrete the bacillus for long periods Bythell (1946) described outbreaks of 12 cases in all, one in Shropshire, and one in Staffordshire in 1945, when all the cases were fatal Grunsell and Osborne (1948) found sporadic cases due to *Sal dublin* on five farms in the Glastonbury (Somerset) area The organism was isolated both from the faeces and the milk of infected animals Field (1948) diagnosed bovine salmonellosis on 70 farms in west Wales during the two years 1946-47 Most of these resulted during the warmer (June-October) months of the year In all but four the strain responsible was *Sal dublin* In his cases most of the animals which recovered remained carriers, and were responsible for a number of subsequent infections, mostly to calves He also showed that this strain can survive for long periods in faeces and also in water

With such widespread herd infections, it is surprising that more human outbreaks from milk have not been recorded One typical outbreak due to *Sal dublin* occurred in a Wiltshire school (Conybeare and Thornton, 1938) with over 100 children affected with gastro-enteritis, the vehicle being the school milk consumed raw This strain was isolated from the patients, from the milk, and from the dung of one of the cows The Knaresborough outbreak of 1944 (Sutherland and Berger) with at least 162 cases had exactly the same origin In this outbreak the infective cow was transferred to the Weybridge laboratory for later investigation, and Rankin and Slavin (1947) found that the bacillus continued to be excreted in very large numbers (at one time 2,580 per g in the excreta), but milk samples were negative

Other Milk-spread Diseases

Foot and mouth disease is an infection of cows which may be transmitted to man, but is decidedly rare Whether infection is always direct or can be transmitted through milk is uncertain, but Dlugosz (1943) who describes two clinical cases without, however, any information as to method of infection, mentions that French scientists have experimentally proved infection through drinking milk (The original reference cannot be traced) Anthrax readily affects cows, but the animals die so quickly that spread through milk is a very unlikely contingency In 1910 there was an extensive outbreak of anthrax in Chicago, involving 20 farms, and 87 cows died, but no persons were infected through milk

The spread of epidemic poliomyelitis through infected milk has been advanced, but a study of the evidence shows that it is inconclusive and at present a verdict of "not proven" seems the correct attitude Those interested will find evidence in favour of transmission in individual outbreaks in papers by Jubb (1915), Watts (1927), Aycock (1927), and Goldstein *et al* (1946)

Milk Products

The only milk products which require consideration are cream, butter, and cheese

Cream—Cream being merely part of milk can convey all the diseases spread by milk if it is unpasteurized Tubercle bacilli have frequently been found in raw cream For example, Pullinger (1942) found tubercle bacilli in 16 out of 31 samples and *Br abortus* in 11 out of the 31

Cream has been responsible for several outbreaks of paratyphoid fever (Savage, 1942) but less frequently than artificial cream Typhoid fever outbreaks due to cream seem to be very infrequent although the typhoid bacillus survives for a good many days in cream, and Brock (1903) found survival for at least 10 days It has been the vehicle in a good many outbreaks of staphylococcus food poisoning, but is rarely a vehicle in salmonella poisoning

Butter—Theoretically tubercle bacilli should not be infrequent in butter, but most investigations show a very low prevalence For instance Edington (1934) out of 40 samples (14 from Denmark, 25 from New Zealand, and one from Australia) found it in only one Danish sample Pullinger (1935) failed to detect it in 39 samples, all except nine home produced *Br abortus* was also absent Smith (1934) examined 51 samples of butter prepared on individual farms and five showed tubercle bacilli but no *Br abortus*, but another series of 15 samples of English dairy butter, five of colonial, and eight from foreign sources were free from both organisms

Pullinger and Kemp (1938) have shown that various salmonella strains (including *B paratyphosus B*) can survive in both salted and unsalted butter for at least two months Theoretically, therefore, they could be responsible for outbreaks of salmonella food poisoning, but the writer knows of no reported outbreaks either of this condition or of enteric outbreaks in Great Britain On the other hand Studeny (1947) in Austria has reported three outbreaks of paratyphoid fever with butter as the vehicle The first outbreak at Graz in 1940 of 143 cases was traced to butter supplied from a central factory and due to a paratyphoid carrier on the staff Although a new factory was erected, a second outbreak was traced to a carrier on the staff of this

factory also, 365 cases were spread by milk and butter. The third outbreak of 35 cases was from farmhouse butter derived from different hill farmers

Cheese.—Cheese has been responsible for numerous outbreaks, and the literature is so extensive that space will only permit of a general summary. Direct experiments show that bovine tubercle bacilli can survive in cheese for many months, and Pullinger (1935) has demonstrated it on four out of 63 samples of cheese from various sources. No examples of human infection have been recorded, but such evidence is almost impossible to establish.

Br. abortus can rarely be found in cheese, and Smith (1934) failed to isolate it from 63 samples from various sources. On the other hand direct experiments have demonstrated its survival after inoculation for periods up to 60 days, but rarely beyond 50 days. Gilman, Dahlberg, and Marguardt (1946) specially studied survival and concluded that an ageing period of 60 days is adequate for safety.

The likelihood of infected cheese spreading undulant fever seems remote, but this does not seem true for infections by *Br. melitensis*, for Celli (1944) has reported a small outbreak in Italy, and Veloppe and Jaubert (1925) an outbreak of 14 cases and two deaths from cheese eaten freshly made.

For well over 60 years cheese has been reported as responsible for outbreaks of food poisoning. Under the influence of the investigations by Vaughan (1903) these were ascribed to tyro-toxicon, a ptomaine-like body, but this conception has long been abandoned. Cheese continues to be a vehicle of food poisoning due either to salmonella strains or of enterotoxin type. Savage and White (1925) in their report of 100 outbreaks of food poisoning found that in eight the vehicle was cheese. Experimentally they showed survival of two salmonella strains in cheese up to 30 days but not beyond. Much more recently Tucker *et al.* (1946) held artificially inoculated cheese at 43-48° C. and found survival of *Salm. typhi murium* up to 302 days. This organism was responsible for an outbreak of 384 cases and the vehicle was cheddar cheese sold soon after manufacture.

Many food poisoning outbreaks are recorded by Berberean (1946) in Syria and the Lebanon due to cheese, usually eaten as green cheese and prepared locally. Most are ascribed to *Staphylococcus aureus*. Erkmen (1941) refers to 21 outbreaks of food poisoning type (1937-39) in Turkey from cheese.

The writer is unaware of any recent outbreaks of typhoid fever or paratyphoid fever in Great Britain with cheese as the vehicle, but over recent years a considerable number has been reported in the U.S.A. and particularly in Canada. Some have been extensive. For example, with six outbreaks in Canada the known cases have been 8, 21, 100, 29, 83, and 40, respectively, and of two in the U.S.A. 225 and 77. Most of the cases have one feature in common, that the cheese has been eaten as "green cheese," i.e. before an adequate period of ripening has been allowed to elapse. One report will serve as an example. Menzies (1944) describes three different cheese-borne outbreaks of typhoid fever in Alberta, in 1936, 1938, and 1944. The cases in the 1944 outbreaks numbered 83, with seven deaths all spread over a wide area with only cheese as a common vehicle. In all the cases fresh green Cheddar cheese made from raw milk was consumed. The source was traced to a typhoid carrier working in the production factory. These outbreaks raise the problem of the survival of typhoid bacilli in cheese, and Campbell and Gibbard (1944) studied this with three strains. Survival varied with the temperature of holding. At 40-42° F. survival was 182-336 days whereas at 58-60° F. it was from 35 to 196 days.

Canada, and at least seven states in the U.S.A. now require cheese to be made either from pasteurized milk or cream or to be held in storage from 60 to 120 days in the U.S.A. and for 90 days in Canada.

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A STUDY ON BIRTHWEIGHT AND INTELLIGENCE

BY

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Introduction

The mental development of the premature or immature child has been studied by a number of investigators The literature has been summarized recently by one of us (Asher, 1946) But although there is a considerable body of information on the subsequent intelligence of children of low birthweight, so far as we are aware no study has been carried out on the general relation of birthweight to intelligence in the population as a whole Doubtless this is due to the formidable difficulty of following up after a sufficient number of years groups of children whose weights were accurately measured at birth But is there no other approach ? It is a matter of common experience that most mothers do in fact remember the birthweights of their children, often being able to quote them to the nearest ounce after the lapse of many years The *a priori* objections to using this information are obvious enough The mother of several children may get their birthweights mixed up The weight as given to her may have been inaccurately determined A proportion of mothers will have forgotten and the distribution of forgotten birthweights may not be the same as those that are remembered, there might well be a tendency, for example, for unusually high or low weights to be remembered more frequently than the rest Nevertheless, it seems possible that for the comparison of the means of relatively large groups, weights as recollected by the mothers might be usable, for it is to be expected that errors of most types will be more or less randomly distributed Accordingly it was decided to obtain from mothers the birthweights of a sample of children of school age The distributions so obtained could then be compared with the distributions obtained from accurate hospital studies Should this comparison prove satisfactory, the relation of birthweight to intelligence could then be examined, to a first approximation, by comparing the distributions of birthweights of children at schools and institutions of various types and containing children of very different mean intelligence

It may be helpful to summarize here the results of our investigation The frequency distributions of a sample of birthweights as recollected by the mothers correspond closely with those of an accurately measured hospital sample, there is no difference between schools of different type, containing children of very different mean intelligence, children at special schools for the educationally subnormal and certified mental defectives differ from the rest in showing a large excess of low birthweights and a small excess of very high birthweights, but there is no shifting of the frequency curve as a whole.

The Composition of the Samples

For the benefit of those who may not be familiar with the present English school system it should be explained that children first attend a primary school Apart from the mentally defective and very backward, the primary schools contain children of all levels of intelligence At the age of about 11+ the children proceed to a secondary school, the cleverest, as judged by a scholarship examination, or a group intelligence scale, or more usually both, pass on to a secondary grammar school, the remainder to a secondary modern school From the point of view of intelligence the distinction is a sharp one The mean Binet I Q of secondary grammar school children is about 120, that of secondary modern school children is about 95

Children who are ascertained under the Education Act (1944) as being educationally subnormal and requiring special educational treatment may be admitted, at any stage of their school career, to special schools for the educationally subnormal For brevity the term special school is used throughout this paper, and it will be understood that it is solely this kind of special school that is meant and not any of the other types provided for children handicapped in other ways The proportion of children attending these special schools is

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relatively small Furthermore, the proportion differs considerably in different areas, for there is legitimate diversity of opinion as to the best way of catering for backward children For example, in some areas many are accommodated in special classes at the ordinary schools In the County of Middlesex the percentage of children (ages 5-16) at special schools is at present 0 38, in the London County Council area it is 0 73 The great majority of these children have Binet I Q s ranging from 50-75, rather less than 10 per cent having I Q s outside this range Selection is not made, however, solely on the basis of I Q , though, of course, when a child has been submitted for examination on account of backwardness the I Q level is naturally an important factor in determining disposal.

The sample of children attending the ordinary schools was obtained from the Borough of Finchley, Middlesex. It should be mentioned that whereas the primary and secondary modern schools situated in the borough cater for Finchley children, there is a good deal of overlapping in regard to secondary grammar schools In particular, the large boys' school shown in Table IV includes many pupils from outside the area, this explains the excess of boys in this portion of the sample

There are four special schools in Middlesex and these formed the original special school sample It was later decided to enlarge this important part of the material, so birthweights were obtained from seven additional special schools, situated in the London County Council area

The sample of birthweights of certified mental defectives was obtained from Stoke Park Colony, Stapleton, Bristol

Ascertainment of the Birthweights

Through the schools slips were distributed to the mothers of the children asking them to fill in the birthweight Rather more than 80 per cent of the slips were duly completed, the main reason for omission being, of course, that the mother had forgotten. The birthweights of the mental defectives were ascertained (with the help of the local health authorities) in the same way

It was thought best simply to ask for the birthweight, without specifying how this should be stated for example, in pounds and ounces, or to the nearest quarter-pound This has naturally produced a rounding off of the figures, as is shown by the distribution of the first 5,177 birthweights (the whole sample, less the extra special schools and the mental defectives) The observed frequencies compared with those expected had measurements been made to the nearest ounce are shown in Table I

TABLE I

Rounding-off of Birthweights (First 5,177) by Mothers

	Frequencies	
	As Given by Mother	Expected (Weights taken to nearest oz)
To whole pound	1,375	323 6
To half-pound	1,399	323 6
To quarter-pound	583	323 6
To three-quarter pound	589	323 6
To intermediate ounces	1,231	3,882 7
Total	5,177	5,177 1

There was a strong tendency for weights to be given either to whole pounds or half-pounds, but fortunately none for whole pounds to be given more often than half-pounds, there was a slighter tendency to round off to the quarters and three-quarters Thus the material can be grouped in one way only namely, in half-pound groups with whole and half-pounds at the group centres The quarter and three-quarter observations were distributed between the groups above and below in proportion to the numbers in those adjacent groups The figures used for doing this were obtained from the whole original sample of 5,177, girls and boys were kept separate The same figures were used for distributing the quarters and three-quarters amongst the additional special school sample and the mental defectives The frequency distributions obtained are shown in Table II The fractional frequencies are, of course, due to the distribution of the quarters and three-quarters

Comparison of the Birthweights with an Accurately Measured Sample

An excellent sample of birthweights with which to compare the present material is that of Martin (1931) His series was composed of live births at Queen Charlotte's Hospital, London, during the years 1922-25 Thus both samples consist of children drawn from Greater London, the numbers are fairly similar, twins are included in both The one important difference is that Martin's sample included all live births, while ours represents survivors to various school ages In our sample the special school and mentally defective children are heavily over-represented (this fraction of the child

TABLE II

Frequency Distribution of Birthweights*

Group Central Weights (lb)	Ordinary Schools				Special Schools	Mental Defectives		
	Primary	Secondary Grammar	Secondary Modern	Total		Feeble-Minded	Imbeciles	Idiots
				Girls				
1 5	—	—	—	—	—	—	1 0	—
2 0	1 0	—	—	1 0	2 0	—	—	—
2 5	1 0	—	7 7	8 7	3 0	1 0	—	—
3 0	2 0	—	0 5	2 5	6 0	—	2 0	—
3 5	5 4	—	10 2	15 6	6 8	—	1 4	1 0
4 0	11 4	2 8	12 4	26 6	6 4	—	2 6	1 0
4 5	21 7	6 6	10 3	38 6	10 8	1 0	1 7	—
5 0	38 1	11 0	13 8	62 9	18 2	—	4 3	3 4
5 5	46 2	9 5	22 7	78 4	19 3	—	3 3	2 9
6 0	118 6	23 5	48 5	190 6	39 3	—	2 7	3 6
6 5	162 8	46 4	79 5	288 7	46 6	1 0	2 8	5 1
7 0	206 5	65 5	109 1	381 1	58 0	3 0	1 2	7 5
7 5	200 4	76 0	118 6	395 0	57 9	2 0	4 2	5 1
8 0	165 3	50 1	86 6	302 0	30 5	2 0	5 4	5 4
8 5	128 4	36 2	68 1	232 7	30 3	1 0	3 4	2 0
9 0	40 5	16 4	27 6	84 5	17 9	2 0	1 0	2 0
9 5	24 9	12 0	15 8	52 7	10 0	1 0	2 0	—
10 0	19 0	5 0	16 2	40 2	5 4	1 0	1 0	—
10 5	3 8	3 0	0 4	7 2	1 6	—	—	—
11 0	1 0	—	1 5	2 5	3 0	—	—	0 5
11 5	1 0	—	1 5	2 5	—	—	—	0 5
12 0	1 0	—	2 0	3 0	1 0	—	—	—
12 5	—	—	1 0	1 0	1 0	—	—	—
Total	1200 0	364 0	654 0	2218 0	375 0	15 0	40 0	40 0

Group Central Weights (lb)	Ordinary Schools				Special Schools	Mental Defectives		
	Primary	Secondary Grammar	Secondary Modern	Total		Feeble-Minded	Imbeciles	Idiots
				Boys				
1 5	—	—	—	—	1 0	—	—	—
2 0	—	—	—	—	1 0	—	—	—
2 5	1 0	—	—	1 0	1 0	—	3 0	0 4
3 0	2 0	1 0	1 0	4 0	1 0	1 0	—	0 6
3 5	1 0	4 0	1 0	6 0	6 5	—	—	—
4 0	9 4	0 3	1 3	11 0	4 5	—	2 0	2 0
4 5	10 8	3 7	5 7	20 2	8 9	—	3 0	1 3
5 0	23 6	18 3	14 4	56 3	18 5	4 0	2 9	4 2
5 5	31 8	20 2	14 7	66 7	17 3	—	6 1	4 8
6 0	78 6	32 5	37 0	148 1	37 4	2 4	10 2	5 4
6 5	134 5	70 8	70 6	275 9	56 7	2 0	21 4	11 5
7 0	195 0	86 7	103 0	384 7	80 0	5 0	12 4	12 7
7 5	221 9	138 7	134 6	495 2	64 3	2 6	15 9	7 2
8 0	160 0	102 6	106 8	369 4	65 4	4 0	21 7	12 4
8 5	145 5	70 2	77 0	292 7	54 1	3 0	11 4	5 6
9 0	91 3	54 5	73 3	219 1	28 1	3 0	10 3	5 9
9 5	43 2	27 7	29 1	100 0	22 8	—	4 2	2 0
10 0	34 8	23 4	25 9	84 1	21 5	1 0	7 5	—
10 5	16 4	4 4	12 0	32 8	5 8	—	5 0	0 8
11 0	5 9	1 0	1 6	8 5	3 2	1 0	—	0 9
11 5	0 3	1 6	2 0	3 9	—	1 0	—	0 9
12 0	—	0 4	1 0	1 4	2 0	—	1 0	0 4
12 5	—	—	—	—	1 0	—	—	—
13 0	—	—	1 0	1 0	—	1 0	—	—
Total	1207 0	662 0	713 0	2582 0	502 0	31 0	138 0	79 0

* Fractional frequencies are due to distribution between adjacent groups of weights given to ½ lb and ½ lb

population is numerically very small) so they have been omitted altogether in-making the present comparison Martin shows separately first pregnancies, second pregnancies, and subsequent pregnancies Order of birth was not ascertained in our sample, so it is necessary to weight his figures, as given in his Table I, in order to arrive at single means and standard deviations In a survey conducted at Bath (Roberts, Norman, and Griffiths, 1938) the birth order of 3,300 schoolchildren was ascertained Making some allowance for previous stillbirths and deaths, the following weights seem reasonable first children, 0 33, second, 0 27, third and subsequent, 0 40 Even if these weights are somewhat in error for the present sample of children, the differences in the weighted total figures for Martin's series will be very small Anticipating the next section of this paper, no appreciable difference was found between children attending the various types of school (other than special schools), hence these can be added together The comparison is shown in Table III

TABLE III

COMPARISON OF BIRTHWEIGHTS OF NORMAL SAMPLE WITH MARTIN'S ACCURATE SAMPLE

	Mean	Standard Deviation
	Girls	
Martin	7 14	1 19
Present sample	7 21	1 30
	Boys	
Martin	7 47	1 24
Present sample	7 60	1 27

The omission of the special school children and the mental defectives from our sample could not, as the proportions of such children are so small, make a difference of as much as one in the last figures shown A much more important matter is that Martin's sample includes all live births, ours only survivors to various school ages, this must account for some of the difference in means Allowing for this factor, there is close similarity In regard to dispersion, the boys of the two series are very similar, but our girls are somewhat more variable, this is due to four of the schools showing an over-variable frequency distribution of birthweights of girls, as is discussed in the following section

The frequency distributions for the girls and boys at ordinary schools, as shown in Table I above, show considerable departures from the normal form In terms of 3rd and 4th moments, the girls show: $g_1 = -0\ 3131 \pm 0\ 0520$, $g_2 = +1\ 1952 \pm 0\ 1039$ and the boys

$g_1 = -0\ 0765 \pm 0\ 0482$, $g_2 = +0\ 6252 \pm 0\ 0963$

Thus in both sexes there is negative skewness, highly significant in the girls, but not attaining the 5 per cent level in the boys There is marked and highly significant positive kurtosis in both sexes

Martin's frequency distributions are not given in a form permitting similar calculations, but it is possible from his Table IV to compare observed and expected numbers falling into broad groups It should be mentioned that his Table IV comprises 3,443 boys and 3,269 girls, whereas the means and standard deviations have to be based on the somewhat larger numbers of his Table I, 3,526 boys and 3,329 girls This cannot, however, make any appreciable difference In assembling our birthweights into similar broad groups, the group boundaries cannot be made the same as his $4\frac{3}{32}$, $5\frac{3}{32}$ $9\frac{3}{32}$ Ours have to be the slightly higher figures $5\frac{1}{4}$, $6\frac{1}{4}$ $10\frac{1}{4}$ In view of our higher means, however, this is probably not a disadvantage The comparison is shown in Table IV

The closeness of the correspondence is remarkable, especially in the girls It is clear that the frequency distribution of human birthweights departs considerably from the normal form, being negatively skewed with positive kurtosis, our series has faithfully reflected this fact

To sum up the results of this section, a sample of birthweights based on the recollections of mothers of children of various school ages, with all the omissions due to lack of knowledge or forgetfulness, and including all the errors that might have been anticipated, has yielded a frequency distribution which corresponds closely with that of a sample of highly accurate birthweights obtained at a maternity hospital in means and dispersions showing reasonable agreement, in the actual form of the curve, in type and amount of departure from normality, a remarkably close correspondence There seems every reason to anticipate that birthweights obtained in this simple and trouble-free way should be reliable enough for the comparison of relatively large groups So, heartened by this result, we can now proceed with some confidence to examine differences between groups within our sample

ANALYSIS OF THE DIFFERENCES BETWEEN SCHOOLS (OTHER THAN SPECIAL SCHOOLS)

In addition to examining the differences between the three types of school containing normal children it seemed advisable to examine also the differences

TABLE IV

DEPARTURES FROM NORMALITY MARTIN'S SERIES AND PRESENT SERIES

Martin's Series					Present Series				
Group boundaries (lb)	Exptd no	Obs no	Obs - exptd	χ^2	Group boundaries (lb)	Exptd no	Obs no	Obs - exptd	χ^2
				Girls					
$4\frac{11}{12}$	111 4	125	+13 6	1 660	$5\frac{1}{4}$	144 8	155 9	+11 1	0 851
$5\frac{11}{12}$	446 1	361	−85 1	16 234	$6\frac{1}{4}$	363 2	269 0	−94 2	24 432
$6\frac{11}{12}$	974 1	910	−64 1	4 218	$7\frac{1}{4}$	625 8	669 8	+44 0	3 094
$7\frac{11}{12}$	1039 1	1,191	+151 9	22 205	$8\frac{1}{4}$	613 0	697 0	+84 0	11 511
$8\frac{11}{12}$	541 8	543	+1 2	0 003	$9\frac{1}{4}$	341 6	317 2	−24 4	1 743
$9\frac{11}{12}$	138 3	122	−16 3	1 921	$10\frac{1}{4}$	108 1	92 9	−15 2	2 137
	18 2	*17*	*−1 2*	0 079		21 5	16 2	−5 3	1 307
	3269 0	3,269		46 320		2218 0	2218 0		45 075
				Boys					
$4\frac{11}{12}$	77 8	78	+0 2	0 001	$5\frac{1}{4}$	81 9	98 5	+16 6	3 365
$5\frac{11}{12}$	345 1	305	−40 1	4 660	$6\frac{1}{4}$	287 3	214 8	−72 5	18 295
$6\frac{11}{12}$	866 4	810	−56 4	3 671	$7\frac{1}{4}$	640 1	660 6	+20 5	0 657
$7\frac{11}{12}$	1117 9	1,195	+77 1	5 317	$8\frac{1}{4}$	786 9	864 6	+77 7	7 672
$8\frac{11}{12}$	738 2	760	+21 8	0 644	$9\frac{1}{4}$	536 7	511 8	−24 9	1 155
$9\frac{11}{12}$	250 3	242	−8 3	0 275	$10\frac{1}{4}$	201 9	184 1	−17 8	1 569
	47 3	53	+5 7	0 687		47 2	47 6	+0 4	0 003
	3443 0	3,443		15 255		2582 0	2582 0		32 716

Degrees of freedom=4, Martin, boys, P<0 01, remainder, P<0 001

between schools of the same type, thus making some assessment of the internal consistency of the figures The means and standard deviations for the 14 schools are shown in Table V Thirteen were mixed schools, one was a boys' school

An analysis of the variation of the means is presented in Table VI

It will be seen that the school means for the girls do not reveal any evidence of significant heterogeneity, either between school types, or between schools within school types There is significant, though not highly significant, variation between school types amongst the boys This is due to the secondary modern boys (i e the dullest) being somewhat heavier than the remainder As, however, the secondary modern girls attending the same schools are slightly lighter than the remainder, it does not seem necessary to attach any importance to this moderate discrepancy As in the girls, schools of the same type are homogeneous

The homogeneity of the variances may be examined by Bartlett's method (1937) For the boys $-2\log\mu$ is 5 22, this is distributed as χ^2 for 13 degrees of freedom and so the school variances are perfectly homogeneous It is the more remarkable to find, therefore, that the school variances of the girls are distinctly heterogeneous, $-2\log\mu$ is 42 33, which with 12 degrees of freedom is highly significant Actually, the heterogeneity is entirely due to four schools, one primary and three secondary modern, which are far more variable in their birthweights than the rest This, of course, makes the secondary modern birthweights significantly more variable than those of the other types of school

TABLE V

BIRTHWEIGHTS OF NORMAL CHILDREN NUMBERS, MEANS, AND STANDARD DEVIATIONS, SEPARATELY BY SCHOOLS

School	Girls			Boys		
	No	Mean	Standard Deviation	No	Mean	Standard Deviation
Primary						
1	245	7 270	1 149	221	7 429	1 260
2	113	7 151	1 218	135	7 559	1 305
3	236	7 133	1 325	254	7 638	1 258
4	180	7 119	1 199	184	7 510	1 228
5	99	7 209	1 237	117	7 624	1 363
6	173	7 116	1 212	151	7 523	1 248
7	154	7 245	1 387	145	7 527	1 245
Total	1 200	7 179	1 245	1,207	7 542	1 266
Secondary Grammar						
1	184	7 367	1 162	153	7 615	1 196
2	180	7 307	1 184	166	7 687	1 310
3	—	—	—	343	7 534	1 250
Total	364	7 337	1 172	662	7 591	1 253
Secondary Modern						
1	203	7 239	1 472	193	7 786	1 263
2	122	7 393	1 283	168	7 716	1 283
3	212	7 072	1 531	236	7 702	1 318
4	117	7 206	1 423	116	7 591	1 199
Total	654	7 208	1 451	713	7 710	1 275
Total—all schools	2,218	7 213	1 299	2,582	7 601	1 267

TABLE VI

ANALYSIS OF VARIANCE. CHILDREN ATTENDING NORMAL SCHOOLS

Girls

Variation of Birthweight $(lb)^2$	Degrees of Freedom	Sum of Squares	Mean Square	Variance Ratio	P
Between school types	2	7 048	3 524	2 09	>0 05
Between schools within school types	10	13 309	1 331	—	—
Within schools	2,205	3719 856	1 687	—	—
Total	2,217	3740 213			
Between schools, all types	12	20 357	1 696	1 01	—

Boys

Variation of Birthweight $(lb)^2$	Degrees of Freedom	Sum of Squares	Mean Square	Variance Ratio	P
Between school types	2	12 693	6 347	3 96	0 05—0 01
Between schools within school types	11	11 807	1 073	—	—
Within schools	2,568	4115 577	1 603	—	—
Total	2,581	4140 077			
Between schools, all types	13	24 500	1 885	1 18	—

and also the whole sample of girls more variable than the boys If the three largest variances are omitted $-2\log\mu$ is reduced to 12 10 and so becomes non-significant It is very curious that the girls at these four schools should be so variable in birthweight, whereas the boys attending the same four schools—drawn from the same areas and often from the same families—should show no such difference We have no explanation to offer and the finding remains a disturbing one

Reviewing the evidence as a whole we are disposed to conclude that it is safe to use the material for the comparison of large groups, the homogeneity of the school means in the girls, with only a slight departure in regard to school types in the boys, and the homogeneity of the school variances in the boys, do seem to point to a body of data that is sufficiently reliable for this purpose, even though four schools are over-variable in the birthweights of the girls *And, of course, there is the more important fact of* close correspondence with Martin's accurate measurements dealt with in the preceding section

Lack of Association between Birthweight and Intelligence in Normal Schoolchildren

The results of the preceding section show that there is no appreciable difference between the mean birthweights of children attending the three types of school To summarize the figures

Type of School	Mean Birthweight (lb)	
	Girls	Boys
Primary	7 18	7 54
Secondary Grammar	7 34	7 59
Secondary Modern	7 21	7 71

If there were an association between high intelligence and high birthweight, primary school children would be expected to give a mean figure representative of the whole population, whereas secondary grammar school children would be higher and secondary modern children lower Yet with a difference in mean intelligence of well over a standard deviation there is no indication of any corresponding difference in birthweight It can be safely concluded, therefore, that in the general normal population there can be no appreciable correlation between birthweight and intelligence

Anticipating the next section, it may be asked whether there is any indication that there is a higher proportion of low birthweights amongst the secondary modern children compared with the secondary grammar school children The figures show

	Percentage of children below 6 25 lb (boys) and 5 75 lb (girls)
Primary	11 8
Secondary Grammar	10 7
Secondary Modern	11 2

	Percentage of children below 5 25 lb (boys) and 4 75 lb (girls)
Primary	3 8
Secondary Grammar	3 6
Secondary Modern	4 7

This last difference between the secondary grammar and secondary modern schools is not significant ($\chi^2=1$ 89) Some caution is needed in interpreting this finding The proportion of children at special schools is so small that even if they were all included with the secondary modern children, the figures

TABLE VII

Birthweights of Special School Children Numbers, Means, and Standard Deviations separately by Schools

School	Girls			Boys		
	No	Mean	Standard Deviation	No	Mean	Standard Deviation
1	52	6 605	1 401	74	7 105	1 578
2	41	6 362	1 638	64	7 509	1 121
3	33	7 206	1 785	62	7 258	1 617
4	23	7 630	1 382	28	7 861	1 764
5	25	6 942	1 564	32	7 447	1 536
6	27	6 922	1 455	49	6 920	1 734
7	60	7 133	1 762	—	—	—
8	51	6 878	1 628	—	—	—
9	63	6 869	1 712	—	—	—
10	—	—	—	128	7 459	1 625
11	—	—	—	65	7 756	1 344
Total	375	6 905	1 633	502	7 396	1 552

would not be appreciably changed Secondary modern schools contain some children whose intelligence is almost as low, or fully as low, as that of some children at special schools It cannot be deduced that this small fraction of the very dull does not include an undue proportion of very low birthweights, relatively enormous numbers would be needed, however, to decide the point What can be deduced is that the separation of children into the brighter fraction destined for secondary grammar schools and the duller fraction destined for secondary modern schools has no counterpart in any appreciable excess of low birthweights in the latter type of school In other words, a measurable excess of low birthweights is found only in that portion of the range comprising relatively very low intelligences

Homogeneity of the Special Schools in Regard to Birthweight

Eleven special schools have been included in this study, three being girls' schools, two boys' schools, and six mixed schools The means and standard deviations are shown separately by schools in Table VII

Table VIII shows the analysis of variance

Again using Bartlett's method for testing the homogeneity of the variances, $-2 \log \mu$ is 5 51 for the girls and 16 09 for the boys, distributed as X^2 for 8 and 7 degrees of freedom respectively

The girls are therefore perfectly homogeneous in regard both to school means and variances With the boys there is heterogeneity which just attains the 0 05 level of significance for school means and somewhat exceeds it for variances This seems a satisfactory result, as some evidence of heterogeneity, considerably more pronounced than has actually been found, would not have been surprising The special schools cover a wide area and in view of variations in local policy it might well be that different schools tend to receive rather different types of pupil

Birthweights of Special School and Mentally Defective Children

In view of the uniformity of the mean birthweights of children at primary, secondary grammar, and secondary modern schools, these can be added together for comparison with the birthweights of the special school children and the certified mental defectives The comparison is shown in Table IX The retarded children are lighter and more variable The differences between the normal children and the special school samples are significant, highly so in the boys The numbers of mental defectives are not sufficient for the differences to attain the level of significance, but the same trend is plain

Inspection of Table II shows that these differences are not due to a shifting of the whole curve, but to a large excess of very low birthweights amongst the backward children, together with a much smaller excess of very large weights Within the region 6 25-10 75 lb in the boys and 5 75-10 25 lb in the girls all three distributions are practically identical This comparison is shown in Table X

If, then, the low and very high weights are omitted,

TABLE VIII

Analysis of Variance (Children attending Special Schools)

Girls

Variation of Birthweight (lb)^2	Degrees of Freedom	Sum of Squares	Mean Square	Variance Ratio	P
Between schools	8	35 126	4 391	1 67	>0 05
Within schools	366	962 548	2 630		
Total	374	997 674			

Boys

Variation of Birthweight (lb)^2	Degrees of Freedom	Sum of Squares	Mean Square	Variance Ratio	P
Between schools	7	34 436	4 919	2 07	0 05
Within schools	494	1172 686	2 374		
Total	501	1207 122			

TABLE IX

BIRTHWEIGHTS OF NORMAL, SPECIAL SCHOOL, AND MENTALLY DEFECTIVE CHILDREN NUMBERS, MEANS, AND STANDARD DEVIATIONS

	Girls			Boys		
Type of School	No	Mean	Standard Deviation	No	Mean	Standard Deviation
Normal	2,218	7 213	1 299	2,582	7 601	1 267
Special School	375	6 905	1 633	502	7 396	1 552
Mentally Defective	95	6 752	1 826	248	7 368	1 698

TABLE X

COMPARISON WITHIN BIRTHWEIGHT RANGES 6 25-10 75 LB (BOYS) AND 5 75-10 25 LB (GIRLS) OF NORMALS, SPECIAL SCHOOL PUPILS, AND MENTAL DEFECTIVES

	Girls			Boys		
Type of School	No *	Mean	Standard Deviation	No *	Mean	Standard Deviation
Normal	1967 5	7 475	0 949	2253 9	7 876	0 978
Special School	295 9	7 403	1 006	398 7	7 874	1 043
Mentally Defective	67 4	7 605	1 031	188 5	7 866	1 083

* Fractional frequencies are due to distribution between adjacent groups of weights given to ½ lb and ½ lb

the differences in means vanish, none being significant The backward children are still slightly more variable, but the differences are very small compared with those shown for the total frequency distributions in Table IX Adding together the special school and mentally defective children, the variances are as follows

	Girls	Boys
Normal children	0 9011	0 9557
Backward children	1 0255	1 1132
Difference	0 1244 ±0 0732	0 1575 ±0 0632

The difference is not significant in the girls, but in the boys it is 2 49 times its standard error The curtailing of the frequency distributions has, of course, produced marked negative kurtosis, so reducing the standard errors of the variances This has been allowed for by using the fourth cumulants

Thus over a portion of the range that includes some 88 per cent of normal children, there is no difference in means between normal children, special school children, and certified mental defectives The backward children are still very slightly more variable, but the omission of the low birthweights and of a very small proportion of high birthweights has reduced the original large differences to very small limits

Turning now to the birthweights below 6 25 lb in boys and 5 75 lb in girls, we find the following percentages below these limits

	Girls	Boys	Both Sexes
Normal	10 6	12 1	11 4
Special School	19 3	19 3	19 3
Mental Defectives	30 7	21 2	23 7

The excess of low birthweights amongst both kinds of backward children is very pronounced (It should be noted that the number of mentally defective girls is very small)

In order to make a finer comparison it seems best to treat both sexes together, adding the small sample of feeble-minded to the special school sample (the range of I Q s is not very dissimilar) and also taking idiots and imbeciles together, as they are too few to separate usefully The results are shown in Table XI The same figures are shown in Table XII, but this time as relative proportions, the percentage of birthweights of normal children falling into each frequency group being taken as 100

There is a steady increase in the disproportion as

TABLE XI

COMPARISON OF PERCENTAGES OF LOW BIRTHWEIGHTS IN NORMAL AND RETARDED CHILDREN

Group Boundaries (lb)		Normal	Special School and Feeble-minded	Idiots and Imbeciles
Girls	Boys	(Total 4,800)	(Total 923)	(Total 297)
4 75—5 75	5 25—6 25	7 42	10 25	13 60
3 75—4 75	4 25—5 25	2 95	5 37	5 62
2 75—3 75	3 25—4 25	0 73	2 58	2 83
<2 75	<3 25	0 31	1 19	1 68
<5 75	<6 25	11 41	19 39	23 73

TABLE XII

PROPORTIONS OF LOW BIRTHWEIGHTS IN RETARDED CHILDREN WITH PROPORTIONS IN NORMALS FIXED AT 100

Group Boundaries (lb)		Normal	Special School and Feeble-minded	Idiots and Imbeciles
Girls	Boys			
4 75—5 75	5 25—6 25	100	138	183
3 75—4 75	4 25—5 25	100	182	191
2 75—3 75	3 25—4 25	100	353	388
<2 75	<3 25	100	384	542
<5 75	<6 25	100	170	208

birthweight falls There are four times as many birthweights under 2 75 lb for girls and 3 25 lb for boys as in the normal series and this disproportion becomes steadily less with each increase of one pound in weight.

The difference between special school children and the feeble-minded on the one hand and idiots and imbeciles on the other is smaller than might have been anticipated There does appear, however, to be a slightly higher proportion of small birthweights amongst the low grade defectives, but our series is too small to pursue this point further The chief finding, as far as our figures go, is that an excess of low birthweights seems to be almost as strongly associated with high grade mental deficiency as with idiocy and imbecility

Examination of Table I suggests that perhaps one should go a little higher than the limits chosen in this paper before all discrepancy vanishes, but to add another half-pound, including as low weights girls under 6 25 lb and boys under 6 75 lb, would make the comparison worse, not better, as is shown by the first results of this section Similarly, half a pound is slightly too big a difference to make between the sexes In these matters, however, we are limited by our grouping of birthweights, to which there was no alternative

It remains to compare the very high weights, which we have fixed, after inspection of the frequency distributions, as above 10 25 lb for girls and 10 75 lb for boys Here the figures are so small that we have added together the special school and mental defective samples The comparison is shown in Table XIII

It seems best to compare the large birthweights with those within that range over which normal and backward children do not differ The excess of large weights amongst the backward children is *significant* in the girls ($\chi^2=4$ 74) and highly so in the boys ($\chi^2=10$ 12) It should be recalled, however, that the mothers of the backward children are themselves, on the average, of lower intelligence than the mothers of the normal series, and so there might be rather more mistakes amongst the birthweights as given by them It is very unlikely indeed that the difference can be explained in this way, but with small absolute numbers it is perhaps necessary to be cautious and to await the collection of more ample data before accepting this finding without some reservation

TABLE XIII

COMPARISON OF NORMAL AND BACKWARD CHILDREN OF VERY LARGE WEIGHTS

	Girls			Boys		
	No * 5 75—10 25 lb	No * over 10 25 lb	Percentage over 10 25 lb	No * 6 25—10 75 lb	No * over 10 75 lb	Percentage over 10 75 lb
Normal	1967 5	16 2	0 82	2253 9	14 8	0 65
Backward	363 3	7 6	2 05	587 2	12 4	2 07

* Fractional frequencies are due to distribution between adjacent groups of weights given to ½ lb and ¼ lb

LOW AND HIGH BIRTHWEIGHTS IN RELATION TO MENTAL RETARDATION

It would seem, then, if our conclusions are soundly based, that there is no appreciable general relation between birthweight and intelligence, even idiots and imbeciles show no tendency to be lighter at birth than gifted children, there is no shifting of the frequency curve But mental defectives and very backward children do include a substantial excess of low birthweights and a small excess of very high ones It is tempting, though not of course justifiable on the data of this paper, to translate these findings into the simple statement that very backward children differ from others in regard to birthweight simply in being more often premature or postmature

Considering the low weights first, this study provides no evidence as to whether babies destined to be mentally defective tend to be more often premature than do normal children, or whether the prematurity (or immaturity) is the cause of the mental deficiency In all probability both are true Prematurity with its associated fragile blood-vessels predisposes to intracranial haemorrhage, and it would not be surprising to find that the bulk of the excess is due to mental deficiency which is a consequence of the prematurity If the whole of the excess were to be explained in this way, our figures would indicate that some 7 per cent of mental deficiency amongst children of school age is to be ascribed to this cause This is likely to prove an overestimate, but we do feel that a smaller, though not negligible, fraction may well be so caused If this is true, it is an important fraction, for unlike so much else in the causation of mental deficiency, this is a factor which offers the promise of control and improvement

As regards the excess of very large babies amongst the defectives, it is difficult not to ascribe this directly to the resulting difficult labour and greater liability to birth injury Our figures indicate that 1 per cent of mental deficiency may be caused in this way

It has already been pointed out that the defective and special school fractions are relatively small numerically Hence the observed excess of low weights amongst these children does not mean a bad prognosis as regards subsequent mentality for the individual premature child Even below 3 25 lb for girls and 2 75 lb for boys, where the percentage is multiplied fourfold as compared with normal schoolchildren, the likelihood that any given child below these limits will be mentally defective should not exceed 10 per cent But it is not without significance, perhaps, that of the only two children with birthweights of 1½ lb in our 6,000 (both checked and found to be correct), one was at a special school and the other was an imbecile

These findings seem to agree well with studies on the development of immature or premature babies As already mentioned, the literature has recently been summarized by one of us (Asher, 1946) On the whole there is a rather remarkable agreement on the facts, namely, that a proportion of such children which may be estimated very roughly at 10 per cent is mentally defective or very backward To select one careful study as an example, Rosanoff and Inman-Kane (1934) found that 10 3 per cent of their 381 subjects had I Q s below 76 Where the various writers differ is not so much on the facts, but in the point of view from which they regard them Some, the pessimists, point out that the proportion of mental deficiency is far higher than in children of normal birthweight, others, the optimists, are more impressed by the fact that any given premature child is much more likely to grow up with normal mentality than to be mentally defective

A striking, and perhaps surprising, point about the present study is that low birthweight seems to be almost if not quite as strongly associated with feeble-mindedness and pronounced backwardness

as it is with gross damage resulting in idiocy or imbecility But once again this is in harmony with the findings in the previous study (Asher, 1946) and apparently with the literature generally

It may not be out of place to say a word about the accepted figure of 5½ lb as marking the limit of immaturity First, this study, as well as others, indicates that a sex difference should be made Karn (1947) suggests that the limit should be 0 25 lb higher for boys, the present study indicates a slightly larger difference, about 0 4 lb Further refinements might well include adjustments for parity and also in the case of twins, though these are somewhat less important. Secondly, at least from the point of view of some association with subsequent mental impairment, the accepted limit is a little low As has been shown above, there is evidence of some unfavourable effect up to about 5 75 lb for girls and about 6 25 lb for boys

As regards low and high weights and their association with mental deficiency, this is a preliminary study We have made no attempt to subdivide the defective children by types, or, except very roughly, by grade Our figures are too small for this Far larger numbers are needed and, coupled with this, much more detail There would seem to be good indications that further studies on these lines should lead to useful results

Summary

1 A sample of 4,800 birthweights of children attending primary, secondary grammar, and secondary modern schools was obtained by questioning the mothers The frequency distributions corresponded very closely to those of Martin's series of birthweights accurately measured at a maternity hospital, the resemblance between the two series extended to means, dispersions, and to the type and amount of departure from normality The individual school means and variances were satisfactorily homogeneous except that for some unexplained reason the girls at four schools were over-variable It is concluded that birthweights obtained in this way can safely be used for certain purposes, such as the comparison of the means of large groups

2 There was no appreciable difference between the birthweights of children attending the three types of school As secondary grammar and secondary modern children differ by more than a standard deviation of Binet I Q , it is concluded that there can be no appreciable association between birthweight and intelligence in the general population taken as a whole

3 A sample of birthweights of children attending special schools for the educationally subnormal, and also a sample of certified mental defectives, had lower mean birthweights and also showed more variability than the normal children These differences are entirely due to an excess of very low birthweights amongst the backward children, together with a very much smaller excess of very large birthweights Between the limits 5 75 lb to 10 25 lb for girls and 6 25 lb to 10 75 lb for boys (a range which includes 88 per cent of birthweights of normal children) there was no difference between the normal and the backward series

4 The excess of low birthweights amongst the backward children increases steadily as birthweight falls The excess is not more than about 50 per cent in the region 4 75 lb to 5 75 lb for girls and 5 25 lb to 6 25 lb for boys But there are about four times as many birthweights below 2 75 lb and 3 25 lb respectively in the backward children as there are amongst the normals The excess of low birthweights is little greater amongst idiots and imbeciles than it is amongst the feeble-minded and borderline defectives

5 The fact that special school children and certified defectives form a relatively small proportion of the population means that the figures just quoted indicate that the child of low birthweight is much more likely to be of normal mentality than to be defective or very backward The chance for those of the lowest birthweights, as quoted above, is probably not worse than 10 per cent

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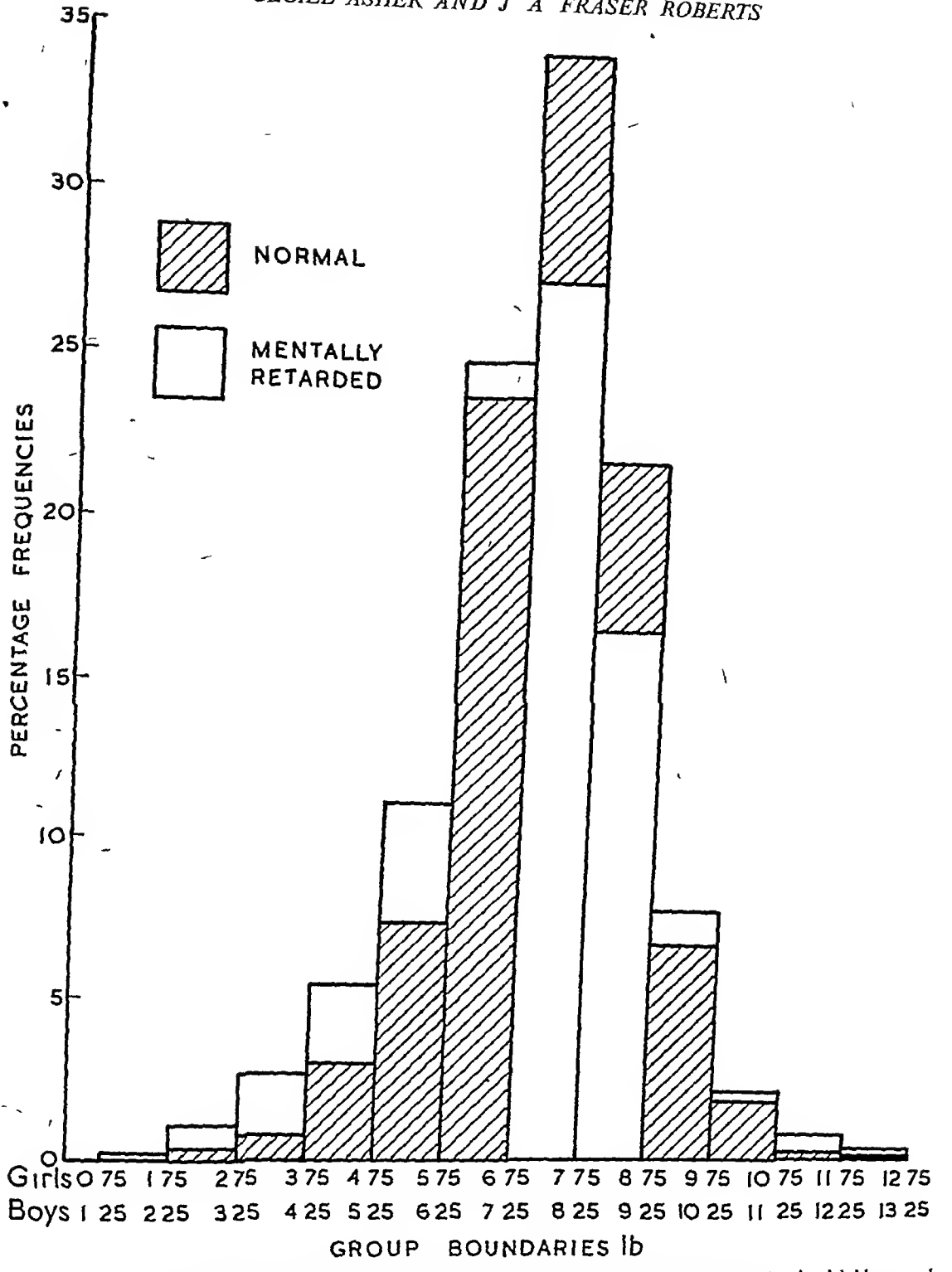

FIG 1.—Comparison of percentage frequency distributions of birthweights of 4 800 normal schoolchildren and 1,220 mentally retarded children (special school and certified defectives)

Brit J soc Med (1949), 3, 69-76

CONTROL CHARTS FOR THE STANDARD MORTALITY RATIO

BY

G HERDAN

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The Registrar General for England and Wales tells us not only how fast our species is killed, but what kills it, and the preference a specified disease has for different age-groups and for different occupations The selectivity in the action of the various killers of our species with regard to social status and occupation has found expression in the so-called Standard Mortality Ratio (S M R) which is the index the Registrar General uses for the purpose of describing the selective action of diseases

The S M R may be briefly explained thus The Registrar General calculates " standard deaths," which are the numbers obtained by applying the general mortality rates of Table 3 of the *Registrar General's Decennial Supplement England and Wales, Part IIA, Occupational Mortality*, 1931, for all males, all married women, or all single women, as the case may be, at the appropriate age-groups, 20-25-35-45-55-65, to three times the census population of the occupational group as given in Table 4 of the Report, and summing the products They represent the deaths which would result in an occupation group if that group were exposed at each age to the standard mortality risks The S M R is the percentage ratio of the deaths actually registered for the group to the calculated standard deaths

There is, however, apart from systematic and accidental errors of diagnosis, a type of error to be taken into account in comparing S M R s This is the error due to the fact that the people following a certain occupation form only a comparatively small sample of the total population Such a sample, if taken at random, may include a greater or smaller number of persons sensitive to the disease in question, or to disease in general That number, provided the sample is truly random, is due to chance only Any increase in the S M R due only to the inclusion of a greater number of sensitive persons must not be put down as due to the occupation or social status We must, therefore, allow for chance fluctuations in the S M R of a population group before judging its S M R for significance

There will be a certain probability for a deviation of a specified magnitude to occur due to chance only The deviation of the S M R from 100 per cent must be considered in the light of these chance deviations (Yule, 1934) The Registrar General's method of doing this is described in his *Decennial Supplement, Part IIA* A table is given from which to read the limits within which a difference in the S M R cannot be considered significant or highly significant. These limits vary with the number of deaths in the population group, and thus with its size In his discussion of the various S M R.s the Registrar General takes the standard error into account But since the report of the Registrar General comprises 176 great folio pages of text and 228 similar pages of tables, some measure of condensation would appear desirable for doctors, and particularly for medical officers, who either cannot spare the time for study, or have not the mathematical stamina for wading through large numerical tables and at the same time applying the criterion of the multiples of the standard errors to every S M R in which they happen to be interested It is with this in mind that the following charts have been constructed The quality control chart (Herdan, 1948) is here introduced as a device for facilitating the use of the standard error in judging the significance of S M R s

The general structure of these charts is as follows

A straight line represents the S M R for the total population (all males, all married women, all single women, as the case may be) for all causes or for specified diseases The curved lines are drawn at distances representing 1 5 and 2 5 of the standard error of the S M R , (adhering to the practice of the Registrar General) and thus including its chance variation in about 14 out of 15 and 160 out of 161 cases respectively on the basis of an assumed normal distribution of the chance variations According to the size of the random sample (more precisely, according to the number of deaths in the population group) these lines are at different distances from the mean line Again adhering to the practice of the Registrar General, they represent the " probable " and " highly probable " border lines between chance variation and true or real differences in the S M R , according to sample size They can also be regarded as a sort of mathematical gauge by which the

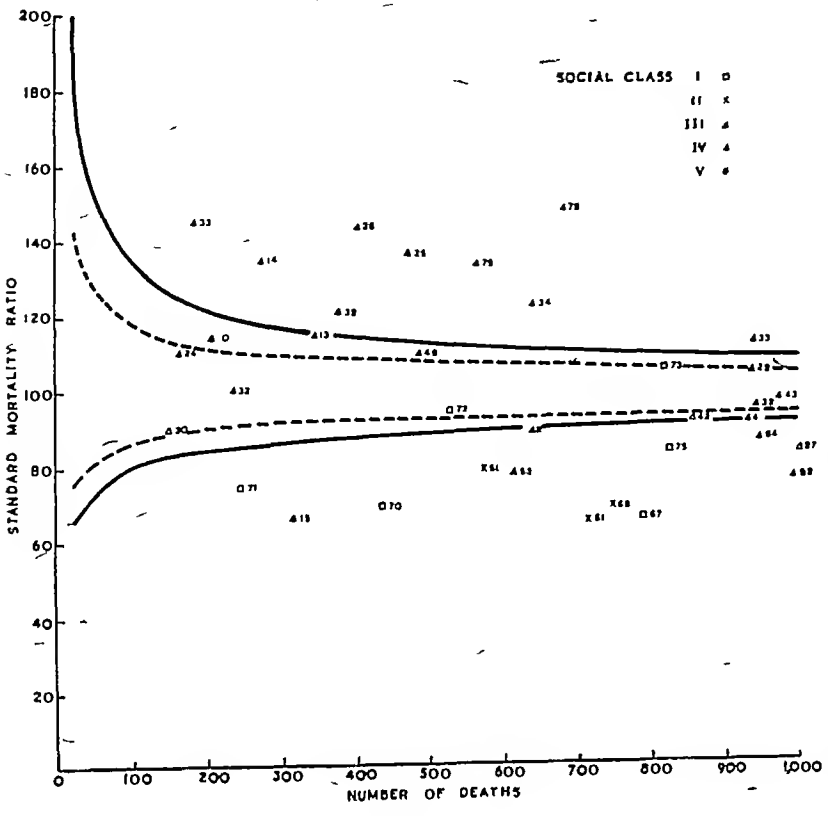

FIG 1

significance of a difference in S M R s is quickly ascertained All we have to do is to plot the S M R for the occupation group in question as the vertical ordinate against the total number of deaths in that group during the time under consideration as the horizontal ordinate or abscissa for the cause or causes in question If the point falls beyond the outer control line (2 5 times the standard error) we can be satisfied of a real difference and may use it as a reliable pointer to further investigation If the point falls beyond the inner control limit (1 5 times the standard error) but not beyond the outer control limit, the difference is probably significant and well worth investigating further

As an illustration of the method the following control charts have been prepared to show in males the S M R for all causes (Figs 1 and 2), influenza (Fig 3), respiratory

TABLE I

KEY TO FIGS 1 AND 2 GIVING LIST OF OCCUPATIONS FOR WHICH S M R. IS SIGNIFICANTLY HIGH AND LOW

High			Low		
Social Class	No	Occupation	Social Class	No	Occupation
I	—		I	67	Bank and insurance officials
				70	Clergymen (Anglican Church)
				71	Ministers of religion (excluding R C)
				75	Professional engineers
II	28	Employers and managers in Occupation Orders VIII-XXI, XXXI	II	1	Farmers and their relatives
				12	Employers and managers gas bricks chemicals, etc.
	77	Inn- hotel-keepers		51	Railway officials
				63	Commercial travellers
				64	Retail salesmen, grocery
				68	Civil Service and Local Authority administrative executive
				74	Teachers (not music)
				81	Draughtsmen, costing clerks, etc
III	4	Coal hewers and getters	III	2	Gardeners nurserymen florists
	14	Potters, ware-makers etc		15	Workers in chemical processes
	16	Furnacemen, rollers and skilled assistants		27	Plumbers (not chemical plumbers)
	17	Metal moulders and die casters		35	Makers of textile goods
	23	Boiler-makers, platers and iron shipwrights		38	Bakers and pastrycooks
	46	Masons		40	Carpenters

tuberculosis (Fig 4), cancer (Fig 5)

For each chart the occupational groups have been listed for which the S M R falls beyond the outer control limits, and thus signifies that the mortality, due to all causes or to the specified diseases, exceeds or is less than that of the total population by an amount which must be regarded as significant

In this way we are not misled by the great number of S M R s, differing from 100 by greater or smaller amounts, which very often mean nothing since they may be due to sampling fluctuations only The comparison between

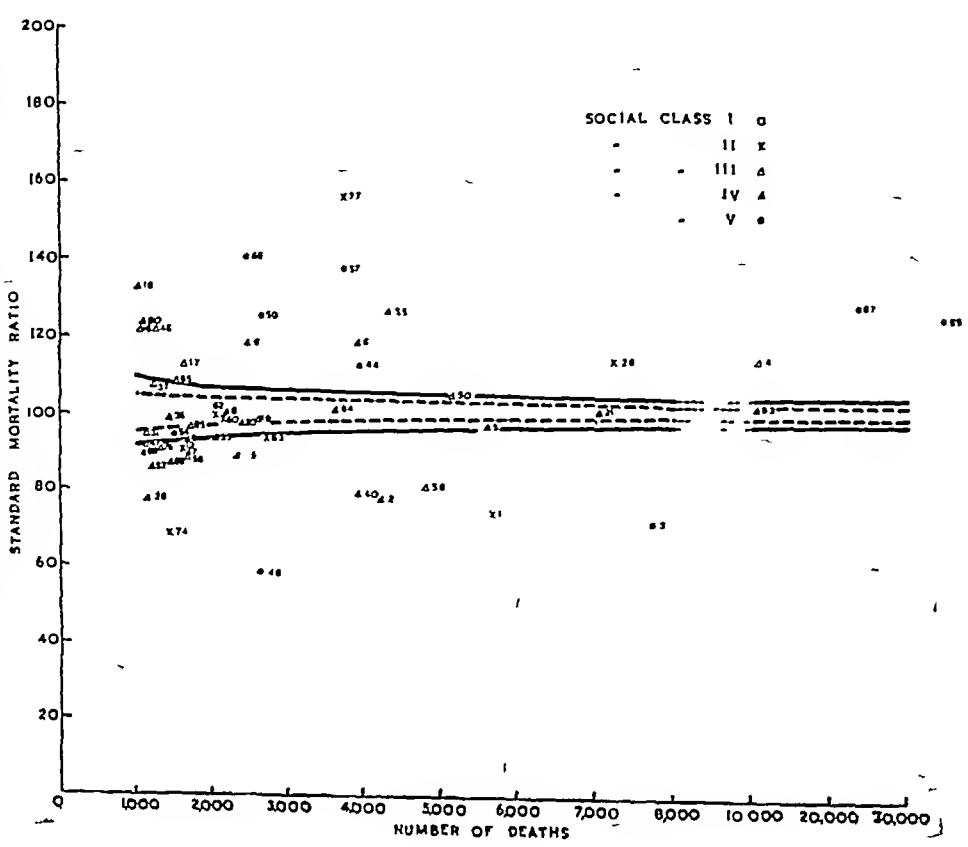

FIG 2

TABLE I—*Continued*

	61	Retail proprietors dairy, meat, fish, greengrocery		45	Bricklayers
	65	Retail salesmen dairy, meat, fish, greengrocery		47	Platelayers
	79	Waiters		52	Railways engine drivers
	80	Hairdressers		53	Railways signalmen
				56	Road transport motor drivers
				58	Postmen and sorters
				69	Police
				76	Domestic servants (indoor)
				82	Typists and other clerks
IV	9	Coal mines workers above ground	IV	6	Coal mines conveying material to shaft
	18	Iron and steel fonndry furnacemen		7	Coal mines making and repairing roads
	25	Metal grinders		11	Stone miners, quarriers
	26	Metal glazers, polishers, etc		86	Boiler firemen and stokers
	33	Textile strippers and grinders			
	34	Textile dyers			
	39	Makers of alcoholic drinks			
	55	Road transport horse drivers			
	78	Barmen			
V	44	Builders, masons, and labourers	V	3	Agricultural and gardeners labourers, etc.
	57	Water transport dock labourers		48	Navvies in building trade, etc
	59	Messengers and porters			
	66	Costermongers, newspaper sellers			
	87	General labourers			
	88	General labourers and other unskilled workers			

CONTROL CHART OF S M Rs, MALES, INFLUENZA

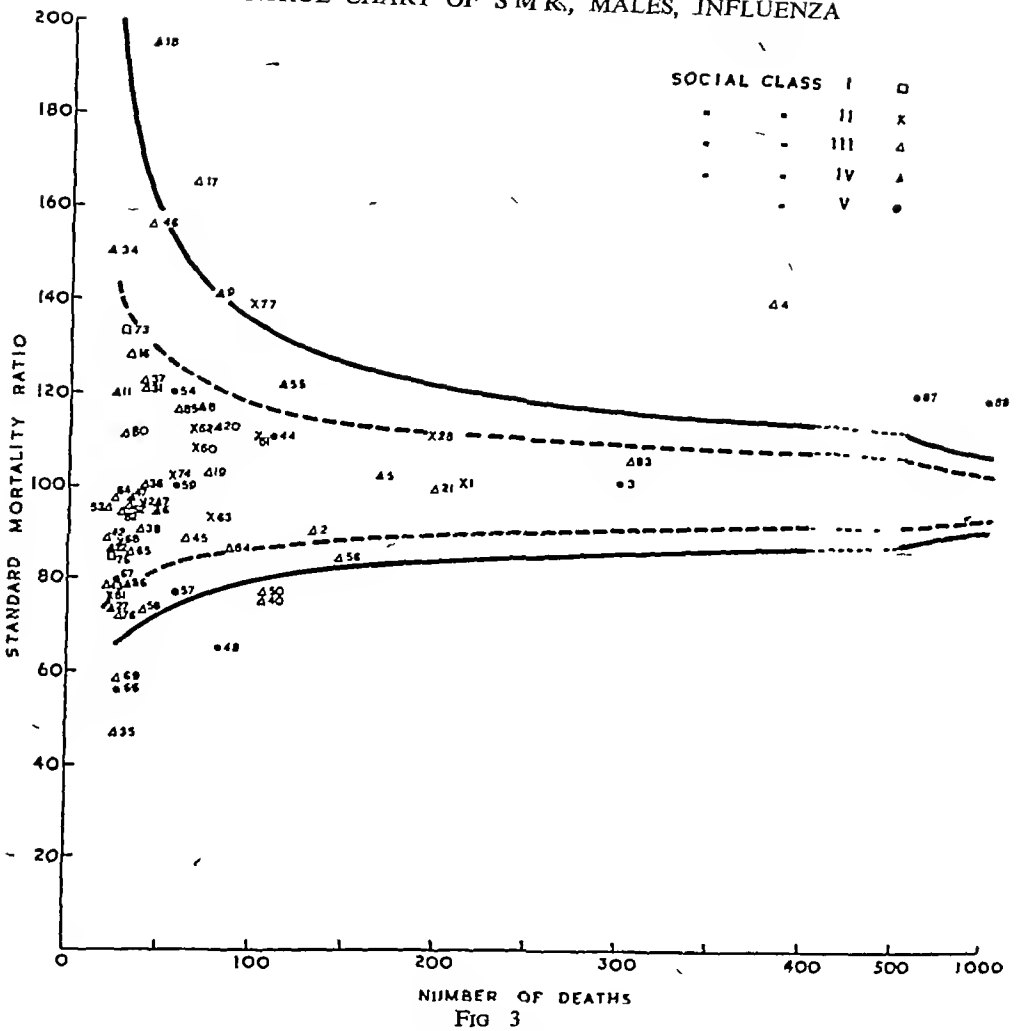

FIG 3

TABLE II

KEY TO FIG 3 GIVING LIST OF OCCUPATIONS FOR WHICH S M R IS SIGNIFICANTLY HIGH AND LOW

High			Low		
Social Class	No	Occupation	Social Class	No	Occupation
I	—		I	—	
II	77	Inn hotel keepers	II	—	
III	4 17	Coal hewers and getters Metal moulders and die casters	III	35 40 50 69	Makers of textile goods Carpenters Paper hangers, painters etc Policemen
IV	18	Iron and steel foundry furnacemen	IV	—	
V	87 88	General labourers General labourers and other unskilled workers	V	48 66	Navvies in building trade etc Costermongers etc. newspaper sellers

the graphs for influenza and respiratory tuberculosis is very instructive in this respect Although even in the former the S M R s often differ widely from one another and from 100, yet most of them are comprised between the outer control limits, thus affording no clue whether influenza is an occupational disease to a high degree

Respiratory tuberculosis, on the other hand, shows a very great scatter of S.M R s, extending considerably beyond the outer control limits, and thus characterizing the disease as highly "occupational" in the wider sense of

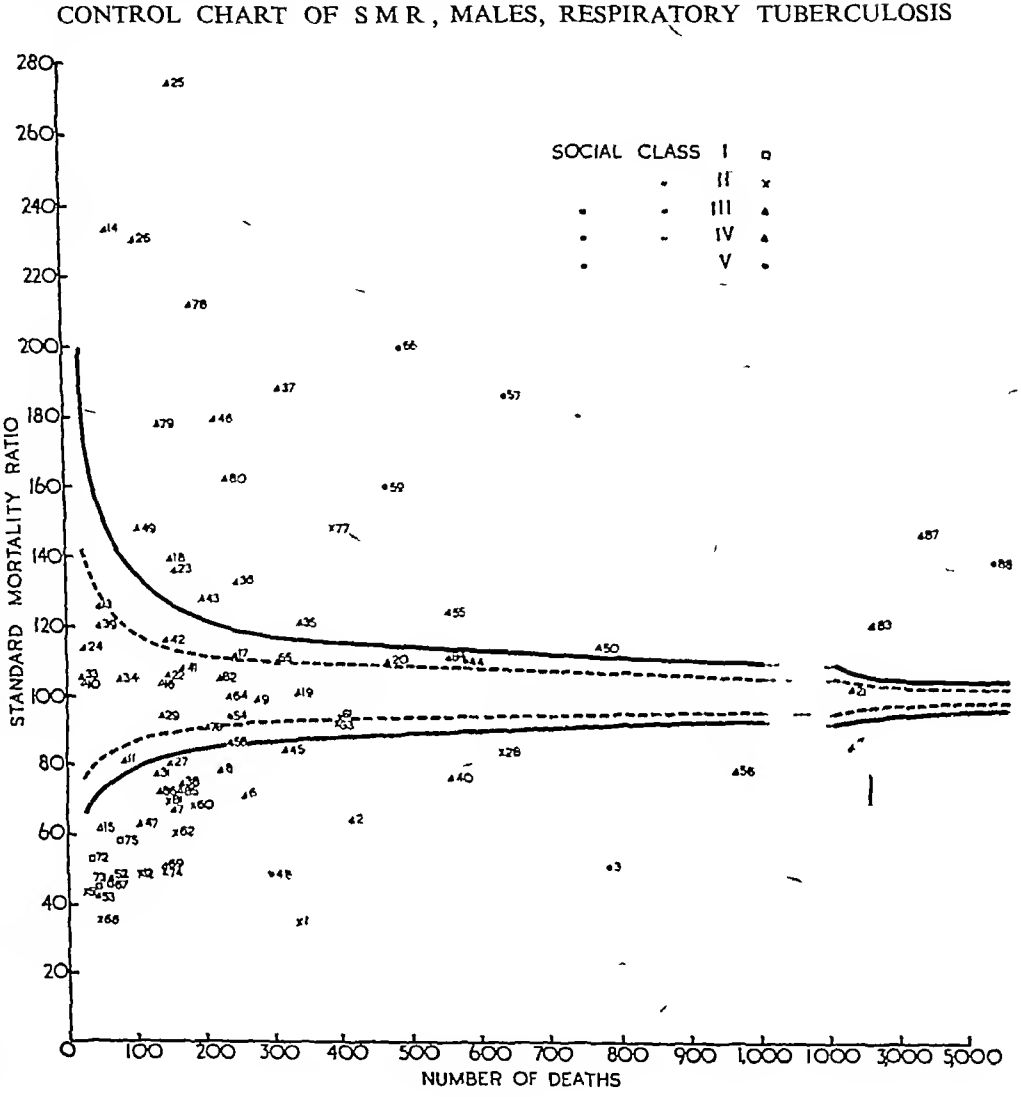

FIG 4

TABLE III

KEY TO FIG 4 GIVING LIST OF OCCUPATIONS FOR WHICH S M R IS SIGNIFICANTLY HIGH AND LOW

High			Low		
Social Class	No	Occupation	Social Class	No	Occupation
I	—		I	67	Bank and insurance officials
				72	Judges barristers solicitors
				73	Physicians, surgeons
				75	Professional engineers
II	77	Inn , hotel keepers	II	1	Farmers and their relatives
				12	Employers and managers gas, bricks, chemicals etc
				28	Employers and managers in Occupation Orders VIII-XXI, XXXI
				51	Railway officials

TABLE III—*Continued*

				60	Retail proprietors, etc., e g grocery
				62	Wholesale proprietors, etc
				68	Civil Service and Local Authority administrative and executive
				74	Teachers (not music)
				81	Draughtsmen, costing clerks, etc.
III	14	Potters, ware-makers etc	III	2	Gardeners nurserymen, florists
	35	Makers of textile goods		4	Coal hewers and getters
	36	Boot and shoe makers, repairers		15	Workers in chemical processes
	37	Boot and shoe workers and factory operatives		27	Plumbers (not chemical plumbers)
				31	Textile weavers (cotton)
	43	Printing machine minders, printers, etc		38	Bakers and pastrycooks
	46	Masons		40	Carpenters
	49	French polishers		45	Bricklayers
	50	Paper hangers, painters etc		52	Railways engine drivers
	55	Road transport horse drivers		53	Railways signalmen
	79	Walters		56	Road transport motor drivers
	80	Hairdressers		69	Police
	83	Typists and other clerks (other than Civil Service)		85	Stationary engine drivers not underground in mines
IV	18	Iron and steel foundry furnacemen	IV	6	Coal mines conveying material to shaft
	25	Metal grinders		7	Coal mines making and repairing roads
	26	Metal glazers, polishers, etc		8	Coal mines other workers below ground
	78	Barmen		47	Platelayers
	87	General labourers		86	Boiler firemen and stokers
V	23	Boiler-makers, platers and iron shipwrights	V	3	Agricultural and gardeners labourers etc
	57	Water transport dock labourers		48	Navvies in building trade, etc.
	59	Messengers and porters			
	66	Costermongers, newspaper sellers			
	88	General labourers and other unskilled workers			

TABLE IV

KEY TO FIG 5 GIVING LIST OF OCCUPATIONS FOR WHICH S M R IS SIGNIFICANTLY HIGH AND LOW

High			Low		
Social Class	No	Occupation	Social Class	No	Occupation
I	—		I	67	Bank and insurance officials
				70	Clergymen (Anglican Church)
				73	Physicians, surgeons, etc.
II	28	Employers and managers in Occupation Orders VIII-XXI XXXI	II	1	Farmers and their relatives
				68	Civil Service and Local Authority administrative, executive
	77	Inn- hotel keepers		74	Teachers (not music)
				81	Draughtsmen, costing clerks etc.
III	16	Furnacemen rollers and skilled assistants	III	2	Gardeners nurserymen florists
	17	Metal moulders and die casters		27	Plumbers (not chemical plumbers)
				40	Carpenters
				53	Railways signalmen
				56	Road transport motor drivers
IV	13	Skilled workers in gas works service	IV	5	Coal mines workers below ground other than hewers
	18	Iron and steel foundry furnacemen			
	39	Makers of alcoholic drinks		6	Coal mines conveying material to shaft
	55	Road transport horse drivers		7	Coal mines making and repairing roads
	78	Barmen		8	Coal mines other workers below ground
V	44	Builders masons, and labourers	V	3	Agricultural and gardeners labourers etc.
	57	Water transport dock labourers		48	Navvies in building trade, etc.
	59	Messengers and porters			
	87	General labourers			
	88	General labourers and other unskilled workers			

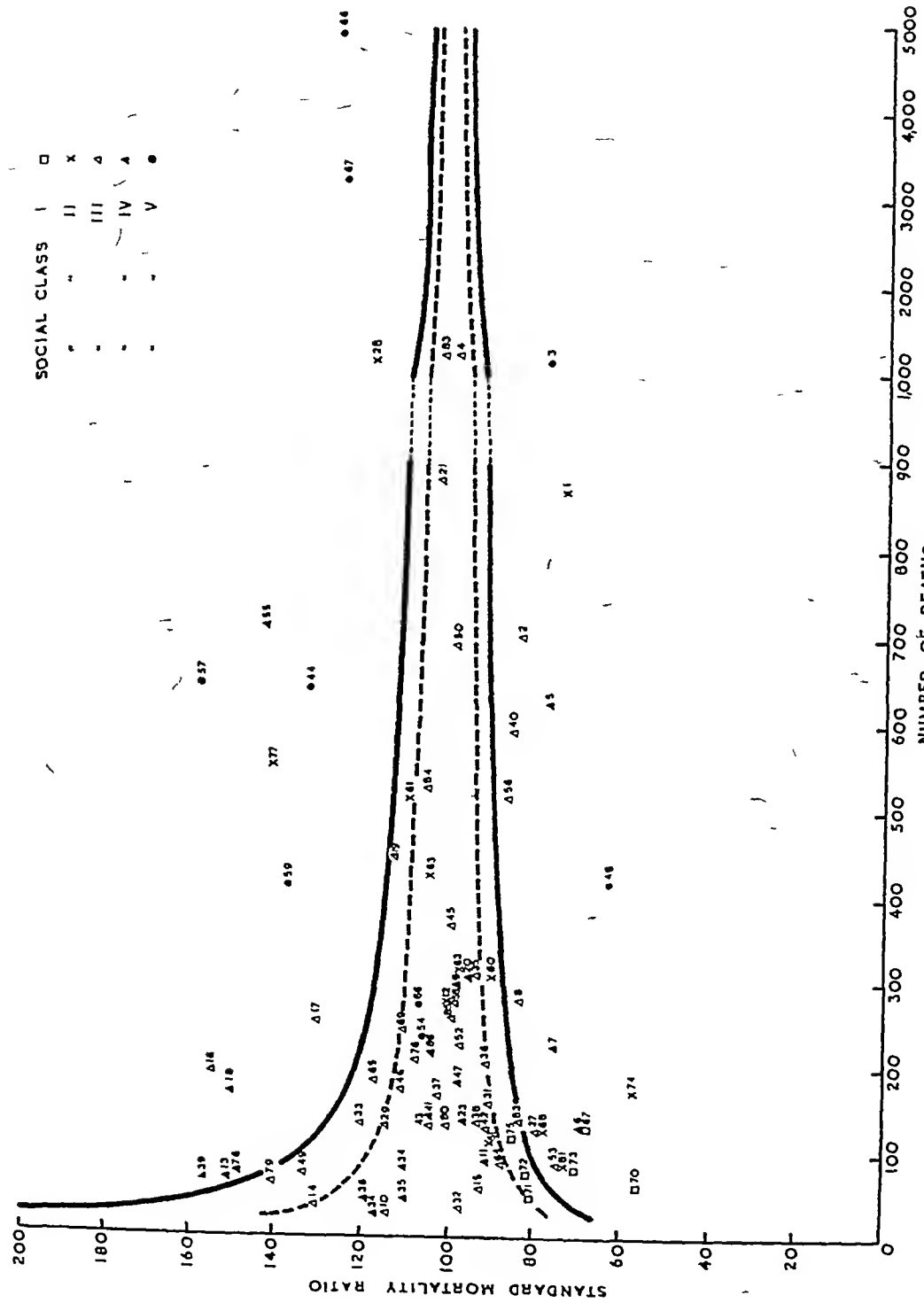
CONTROL CHART OF S M R MALES, CANCER
SOCIAL CLASS I II III IV V
STANDARD MORTALITY RATIO
NUMBER OF DEATHS
200
180
160
140
120
100
80
60
40
20
0
100
200
300
400
500
600
700
800
900
1,000
2000
3000
4,000
5000

FIG 5

the term That is, either the employees of certain occupational groups are at an increased risk of dying from respiratory tuberculosis, or a sort of selection takes place which makes persons afflicted by the disease gravitate to certain occupations more than to others

On the basis of the control chart it is possible to express the scatter of the S M R which is characteristic for a given disease in a single figure One way of doing this is to count the points outside the outer control limits and express their number as a percentage of the total number of points plotted We thus obtain for

Influenza	12/67	18%
Cancer	32/86	37 2%
Respiratory tuberculosis	57/84	67 85%
All causes	60/88	68 2%

For the purpose of comparison between different diseases, or between a specified disease and "all causes," index figures might easily be constructed Taking for instance the percentage of points outside the control limits for "all causes" as our standard of comparison, i e as 100 per cent, the relative scatter for the three specified causes results as — Influenza, 26 5 or approximately one quarter of the scatter due to "all causes", cancer, 54 7 or slightly more than one half of the scatter due to "all causes", respiratory tuberculosis, 99 7 or approximately the same as the scatter for "all causes"

Although the Registrar General distinguishes by means of the S M R: between occupational groups with regard to a specific cause of death, it seems very desirable to have a method for distinguishing between different causes of death with regard to the extent to which they are selective in their action upon occupational groups The integrating device which is needed for doing this is provided by the control chart, giving a complete picture and taking at the same time the standard error of the S M R into account It reveals the degree of significant heterogeneity in the action of a specified lethal agent upon the occupational groups It also enables us to express that degree of heterogeneity, and the difference between different causes of death in that respect by a single index figure

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Brit J soc Med (1949), 3, 77-84

SOCIAL MEDICINE

A STUDY OF THE FIRST HUNDRED PATIENTS OF A UNIVERSITY DEPARTMENT OF INDUSTRIAL HEALTH

BY

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The first report of the Nuffield Foundation (1946), referring to the subject of industrial health, states that

> Industrial hazards and diseases, which hitherto have claimed most attention, do not constitute the whole of the subject departments of industrial health should be closely allied with whatever organization the universities should establish for the study and teaching of social medicine Industrial health is one of the most potent, if still mainly potential, executive branches of social medicine

It is timely now to ask what kind of problems are encountered in the routine practice of a department of industrial health in an area of heavy industry, how does it deal with them, and how does the practice compare with the precepts already laid down (Browne, 1947)

Methods

When clinical work was started a circular was sent out under the joint auspices of the university and its teaching hospital to all general practitioners in the North-East Hospital Region This drew their attention to the formation of the department, and pointed out that it would receive cases of medical industrial disease (with the exception of skin conditions) scheduled under the Workmen's Compensation Acts, together with any other medical conditions in the causation of which the nature of the patient's work was thought to have played a part It was difficult to forecast the response to this circular, but it was thought wiser to aim at one which would be too small rather than too big, hence the rather narrow drafting of the notice

An out-patient clinic was instituted in a suite of three communicating rooms, two for the clinicians who see patients simultaneously, and the third for the social assistant. The patients see the doctor first and then the social worker, because they expect to start by telling a doctor about their symptoms, and until they have done this they are not ready to discuss their social difficulties Also, the social worker would have to take her social history blindfold if she had no indication of the clinical and industrial histories and their possible implications The clinical and industrial notes and the social summary were designed, and are kept, as a whole inside one folder Letters are written to the patients' doctors by the clinician and have references to these three divisions of the whole problem Management is decided jointly between clinician and social worker, and since both are members of the same department, formal case conferences are unnecessary

The same principles guide the in-patient work, which is done in the Department's own beds within the main division of medicine, with which there is the closest connexion

Full details of a single case history will serve to illustrate the scope of the information recorded

> Mr A.B , aged 34 years, had noticed for the last three weeks increasing weakness of the right hand, which had become stiff, clumsy, and useless He had had " stomach cramps ' and constipation for one week
>
> For the last 20 months he had worked as a plate paster in a lead battery works He had also been weighing dry red lead powder and then mixing it with distilled water and sulphuric acid to form a paste His previous occupations were age 14-28, plasterer s labourer, age 28-32, in Army (Royal Engineers)
>
> Physical examination showed him to be a pale, thin man, with a bilateral congenital ptosis more marked on the right Wasting and weakness of the muscles of the right hand, forearm, arm, and shoulder were observed and right wrist drop Sensation was absent over the right hand and forearm, with evening glove distribution present over the arm Examination disclosed no other abnormality Blood examination gave a red cell count of 3 95 mill per cu mm , Hb 71 per cent colour index 0 9
>
> His social history was that he was born in Newcastle-upon-Tyne, son of a regimental sergeant major who

became under-manager of a lead works After marrying at 24, he shared a house with his cousins and later with his in-laws, with whom he is still living together with his wife and three children His employer's comment was that he was one of his best workmen

He had been earning up to £7 10s per week until he became ill, but as soon as he stopped work his wage ceased Sickness benefit was not paid, as there was a question of workmen's compensation His wife had to apply for Public Assistance until the compensation claim was settled He was a nervous man, unsure of himself and easily upset by any suggestion that he might be malingering Controversy over compensation and repeated examinations by different doctors in this connexion made him increasingly introspective and preoccupied with his illness

The patient's factory was visited, it employed only six men, and was established during the 1939-45 war in old accommodation His job was to spread a red lead and sulphuric acid paste on to a solid lead grid about 9 in square Rows of pasted grids were wrapped in paper and taken into the 'drying room," which was merely an area of the main workshop in which there was a coke stove When dry, each plate was broken in half to form two small ones The plates were then packed in boxes In a corner was a small milling machine for trimming the plate lugs, and although this was under an exhaust ventilation hood, a quantity of the metallic lead dust came out into the main workshop The workshop was dry-swept, and the red dust of lead oxide could be seen lying on the lampshades and ventilators On coming to work in the morning, a man took his dusty overalls out of a locker and put in his coat, thereby transferring lead oxide dust from his work to his home clothes

The clinical diagnosis was, therefore, lead poisoning with hysterical anaesthesia of the right arm The social diagnosis was loss of earnings, change of employment, and compensation difficulties, and the industrial diagnosis a slum factory with inadequate management and hygiene

The patient was managed by treatment with bed rest for two weeks, followed by one week's retraining A high calcium diet with vitamin D and ferrous sulphate was given The right wrist was splinted in the 'cock-up" position, and then increasingly active exercises were given to the affected hand and arm

While he was in hospital, the Disablement Rehabilitation Officer from the local employment exchange was asked to see him, as the risk of further contact with lead made it unwise for him to return to any job in the firm where he had previously worked. Before he started work legal advice about his compensation was obtained He was then found work by the Ministry of Labour in a clothing factory Here he took messages, swept the floor, and tied up parcels, and with wages and partial compensation his income was £5 10s per week

He was receiving compensation under the old Workmen s Compensation Act, and after six months the insurance company raised the question of a lump sum settlement The complications which followed were most perplexing to the patient, and no final settlement was made Weekly payments were continued for 11 months, and then discontinued on the grounds that the disability was no longer the result of lead poisoning, The patient's income was thus reduced to £4 per week He still maintained that he could not use his hand for heavy manual work, and he had been obliged to refuse an attractive and better paid job for this reason He felt that he had been unjustly treated, and decided to take the case to court The final results of this unfortunate medico-legal controversy remain to be seen Meanwhile, the patient is being encouraged to take a practical and unemotional view of his difficulties

During the earlier stages of his illness he needed a good deal of help from the social worker, but the support which was given to him then was gradually withdrawn As his self-confidence increased, he became able to take the initiative in dealing with problems for himself, and his morale has improved during the last few months

Two unofficial visits to the patient s former factory by the departmental staff and an official visit from the factory inspector, led to improvements in the level of hygiene These were first shown by improvements in the clothes locker system, together with greater attention to floor damping and cleanliness

Occupational Groups

Sixty-nine per cent of the patients were coal miners, usually coal face workers or men who had been face workers, but for various reasons, often dyspnoea, had changed to less strenuous odd jobbing work paid at a daily rate One patient had mined lead, and another ironstone Four men worked in foundries, and there were two arc welders and three lead workers (one pasting batteries, and two smelters) There were also four tar workers The remaining 16 men were engaged in various occupations which ranged from baker to bus conductor, and included a trinitrotoluene worker, a plumber's mate, a steel erector, a coke worker, and a phenol worker (Table I)

TABLE I

Analysis of Occupations

Occupation		No of Cases
Mining		
Coal	69	
Lead	1	
Ironstone	1	
	—	71
Lead workers		3
Tar workers		4
Foundry men		4
Arc welders		2
Various trades		16
		100

TABLE II

ANALYSIS OF TYPES OF ILLNESS IN THE SERIES

	Type of Illness	No of Cases	Totals
Chest	Pneumoconiosis of coal miners (1 with pulmonary tuberculosis and 1 with miners' nystagmus)	21	
	Siderosis	2	
	Silicosis (1 with pulmonary tuberculosis)	2	
	Pulmonary tuberculosis	5	
	Chronic bronchitis and emphysema	23	
	Other chest conditions	4	57
	Pulmonary oedema, following shot firing 1		
	Carcinoma of bronchus 1		
	Spasmodic asthma 1		
	Acute bronchiolitis, following exposure to metal fume 1		
Intoxications	Trinitrotoluene	1	
	Lead	3	
	Carbon monoxide (9 industrial, 2 other)	11	15
Dermatological	Tar (2 dermatitis, 2 epitheliomas)	4	
	Various	2	6
Miscellaneous	Psychiatric	7	
	Cardiovascular	6	
	Miners' nystagmus	2	
	Various conditions	7	22
			100

MEDICAL PATHOLOGY

Diseases of the chest were found in 57 per cent of the men (Table II) Of these, pneumoconiosis of coal miners (21 per cent) and chronic bronchitis (23 per cent) were by far the commonest conditions diagnosed All the cases of coal miners' pneumoconiosis were in coal face workers, and the radiological changes which they presented are similar to those described by Hart and Aslett (1942) and more recently by Davies and Mann (1948), whose method of classification has been used Sixteen men had simple and five complicated pneumoconiosis (Table III) Two cases of silicosis were seen, one of the nodular type in a steel dresser, and the other in a lead miner with complicating open tuberculosis In both these cases the diagnosis was confirmed at autopsy There were also two arc welders in whom there were radiological changes suggesting siderosis In 23 men there was a diagnosis of chronic bronchitis and emphysema, with varying degrees of disability These were also mostly face workers in coal mines who had been referred to us primarily to exclude pneumoconiosis Their average age was 54 years, compared with an average age of 51 years in those with pneumoconiosis Of other chest conditions seen, there were five cases of pulmonary tuberculosis without any occupational hazard complicating it, and one case each of bronchial carcinoma, spasmodic asthma, acute bronchiolitis following exposure to metal fume, and pulmonary oedema following shot firing

TABLE III

PNEUMOCONIOSIS OF COAL MINERS (CLASSIFIED ACCORDING TO DAVIES AND MANN, 1948)

Type	Category	No of Cases
Simple	1	6
	2	3
	3	7
	4	0
Complicated	A	0
	B	3
	C	1
	D	1
		21

Industrial poisoning, mainly by carbon monoxide, occurred in 13 patients, eight of whom were miners admitted following underground explosions, and one a man who had been working on a gas main Lead intoxication was found in three men two of

whom were engaged in smelting, and the third in battery pasting One man, a TNT worker, was thought to have a toxic gastritis There were no fatal results in all these men

We have not set out to treat skin conditions, but a few (six cases) have been seen, including two of epitheliomata in tar workers A group of seven men in whom the main complaint appeared to be a psychological disorder, were included in the first 100 patients seen, and were reassured or referred elsewhere for specialist treatment

Six patients were found to have disorders of the cardiovascular system, all coal miners except one, and all elderly apart from a miner of 35 years with mitral stenosis Miners' nystagmus was seen in three men, one of whom had a pneumoconiosis for which he had been fully compensated, and whose capacity for work was greatly limited by that alone

Finally, there were seven men in whom various conditions were found chrome ulceration of the nasal septum, chronic nephritis, blepharitis, chronic naso-pharyngitis, laryngeal fibroma (in each case unrelated to occupation), a resettlement problem, and one fit man who had been suspected of having pneumoconiosis

Social Pathology

The most frequent clinical conditions seen were chronic bronchitis, coal miners' pneumoconiosis, and cases of gassing, and it is of value, therefore, to trace the relation of social to medical pathology in those conditions

The commonest and most important social problems found among adult patients are material difficulties connected with employment, income, housing, and domestic care, and the emotional difficulties which may complicate them (Beck, 1947) The number and severity of these difficulties among any group of patients depends on the length of the illness and the amount of disability which it causes A clear-cut illustration of this may be seen in Table IV, where the patients with diseases of the chest and those with carbon monoxide or other gas poisoning have been separated from the rest of the series The patients with chest diseases were not acutely ill, few of them could benefit from medical treatment, and many of them seem from a narrow clinical viewpoint to be rather uninteresting But from a social point of view their pathology was sometimes acute and often highly complex, and they formed an unusually interesting group The men who had been overcome by gas poisoning were very ill and were in urgent need of skilled medical treatment, but they made rapid and complete recoveries Their social difficulties were minimal, and no social treatment was needed The only exception to this was an attempted suicide whose social problems had been the cause, and not the result, of his carbon monoxide poisoning

TABLE IV*

Effects of Illness on Social Background

Disease	Degree of Social Difficulty				
	None	Minor	Serious	Unknown	Total
Pulmonary	3	10	39	3	55
Gas poisoning	10	2	1	0	13
Other	8	8	13	3	32
Totals	21	20	53	6	100

* In this and later tables one patient with bronchiolitis and one with pulmonary oedema both of whom were overcome by fumes while working, have been included in the gas poisoning group and not among diseases of the chest

Problems have been classed as serious when some drastic alteration of the social background was caused by the illness or became necessary as a result of it, or when help was needed to avert hardship and anxiety When the social impact of illness can be met without assistance and does not involve difficult readjustments for the patient or his family, any problems which are present can be classed as minor ones Thus, changing his job is a serious matter to a patient if he cannot find suitable work without help, or if the change means a big drop in income If he is able to find a new job himself at a rate which compares reasonably well with what he got before, this is regarded as a minor problem In the present series of men, most of whom were earning high wages, the economic effects of illness were not rated as serious unless income was reduced by more than 25 per cent Pre-existing social problems which might have precipitated illness or complicated its results were so uncommon that they have not been listed separately

Most of the patients were wage earners with family responsibilities, and the need to change or to cease work often caused a complete dislocation of their own and their families lives Table V, which shows what happened to the men as workers, gives little more than a hint of what it meant to them as complete human beings Less than 40 per cent of the whole group were able to return to their original jobs, and scarcely more than 20 per cent of those with diseases of the chest were able to do so Those who changed their jobs were better off than those who remained idle, but most of them had their income permanently reduced For the men

with chest diseases, most of whom were coal face workers, the change usually involved a weekly drop in income from £8 or more to £5 or less To men in their forties and fifties, who had worked hard for a mere pittance during the lean years, it came as a particularly hard blow to have to give up their work now when it was well paid Nor was the economic hardship the only one, for the change often resulted in a serious waste of human material One man of unusual intelligence and ability, who had been hoping to send one of his children to a university, had worked underground as a deputy, a highly responsible post. He could get no work at all through the Ministry of Labour, and ended up by making clay plugs for shot firing, a type of work suited to the lowest grade of manual worker

TABLE V

EFFECT OF ILLNESS ON WORK TOTAL SERIES

Disease	Work			Retired	Died	Unknown	Total
	Same	Changed	Idle				
Chest	12	15	19	3	3	3	55
Gas poisoning	12	1	0	0	0	0	13
Others	11	11	4	3	0	3	32
Totals	35	27	23	6	3	6	100

The more detailed analysis in Table VI suggests that men with chronic bronchitis are better off than those with pneumoconiosis as regards getting back to work Although the figures are small, they illustrate certain differences Men who had been certified as disabled by pneumoconiosis were legally debarred from returning to underground work, or indeed to any work around the mine apart from a few non-dusty surface jobs, and these often required more physical effort than some of the jobs away from the coal face underground The only men with pneumoconiosis in this series who remained in their old jobs were two who preferred not to take the economic risk involved in making a claim for compensation, and one who was certified as having the disease, but not disabled by it In such cases, a man was allowed to choose whether or not he would accept the verdict If he accepted, he would get half wages for a limited time, but would be debarred from going back to mining, although not entitled to any further compensation This man's decision to continue at work underground seemed sensible enough in the circumstances, but it is worth noting that his union advised him most strongly against it, and only a determined and level-headed man would have persisted in such a course The question of changing their work did not arise for men with chronic bronchitis with similar symptoms, and those who were partly disabled could often get less strenuous work below ground This is reflected in the larger number of men with chronic bronchitis (Table VI) who were able to get different work without changing their employer Under the new regulations for pneumoconiosis compensation, a different policy about suspension from mining may level out some of these differences in the future

TABLE VI

EFFECT OF CHEST DISEASE ON EMPLOYMENT

Disease	Employment				Retired	Died	Unknown	Total
	Same	Changed		Idle				
		Same Employer	Different Employer					
Pneumoconiosis	3	2	4	10	1	0	1	21
Chronic bronchitis	6	9	0	5	2	1	0	23
Other chest conditions	3	0	0	4	0	2	2	11
Totals	12	11	4	19	3	3	3	55

For the miners who could not continue in underground work, the situation was similar whether they had pneumoconiosis or chronic bronchitis If anything, the bronchitics might be worse off, since some priority was given to " compensation cases " in allocating the few available surface jobs When the colliery had nothing to offer, the prospects of getting back to work were poor These men were considered too old to be accepted for training by the Ministry of Labour, even if they could have been placed in their own districts when trained Besides, mining was a way of life to most of them, so that the thought of leaving it struck at the very roots of their communal existence In any case, the plain fact was that alternative work could seldom be found in the districts from which they came One chronic bronchitic had already been on the books of the Ministry of Labour for three years, and he was an intelligent and stable man who was fit for any form of reasonably light work

One of the four men with pneumoconiosis who got work with other employers was the deputy mentioned above who was employed in making clay plugs, and one man was able to get work as a night watchman The two others were younger men of unusual initiative, one of whom lived within travelling distance of a trading estate and found work there, and the other was taken on by his local council as a park and beach attendant The last

appointment may not have been altogether wise, as the duties included life-saving on a part of the coast where bathers often get into difficulties, but the patient managed his first summer season satisfactorily and hopes later to be relieved of this part of his responsibilities

None of the patients with gas poisoning needed to change his job, except for the attempted suicide Among those with other diseases who needed to change was a group of three men with lead poisoning and one with T N T poisoning Only one of these, a leadworker with severe wrist drop, had much difficulty in finding suitable work, and the final effect on income of changing their jobs was not serious for any of them In the whole series, no patient who was physically and mentally fit for work failed to get a job, except in the groups with pneumoconiosis or chronic bronchitis

Seventeen out of the 27 men who changed their jobs did so successfully by their own efforts Seven more were able to get suitable work after we had approached their employers, and three had jobs found for them by the Ministry of Labour Nine other men had been referred to the Ministry of Labour for resettlement, but five of these are still idle, and the other four eventually found jobs for themselves Ten patients with pneumoconiosis and five with chronic bronchitis are still not working at a period from nine months to two years after they were first seen Special attempts were made to find work for three of the men with pneumoconiosis, and three others were well enough to be signed on at the employment exchange, although they had no hope of getting work Unsuccessful attempts were also made to find work for four of the bronchitics Two men with pneumoconiosis and one with chronic bronchitis were probably unfit for anything except some form of home occupation Two other men with pneumoconiosis were primarily disabled by other conditions, one by miner's nystagmus and the other by long-standing peptic ulceration

There was not much to choose between the unemployed men with pneumoconiosis and those with chronic bronchitis as regards fitness for work, but the tendency was for the bronchitics to be rather worse off in this respect, and the social results were often more serious

The average weekly income of the men who were unable to return to work was about £2 Individual amounts might be as little as 10s 6d a week for a man whose national health insurance payments had been reduced They might be as much as £3 or over for men who were drawing unemployment benefit and partial compensation, or whose sick benefit was being supplemented by public assistance As even full compensation at that time was little over £2 per week, the advantage of the men who could be compensated over those who could not was small Under the new rates of insurance and compensation, both classes of men will benefit, but the economic difference between being disabled by pneumoconiosis or by chronic bronchitis will become more marked In certain circumstances a man compensated for total disablement by pneumoconiosis under the new Act might get as much as he would in a light job, but the man with chronic bronchitis will only get half this amount

Throughout the present series, men avoided application for public assistance whenever this was humanly possible, and when savings were exhausted after long absence from work, contributions from children, the earnings of wives, or help from relatives often tided the family over A drastically lowered standard of living and the sacrifices of his family often added to the patient's depression and feeling of uselessness It was this sense of being "on the scrap heap" and of no further use either to their families or to the community, which broke the men's spirits and caused the greatest suffering to all concerned The men with bronchitis in the present series were affected in this way more seriously than those with pneumoconiosis

Contrary to what might have been expected, not one of the patients with pneumoconiosis became preoccupied with compensation The legal aspects of their illness caused some disturbance in two of the men with lead poisoning, but this did not seriously hinder their return to work More serious compensation disturbances were found among unstable patients who had not got industrial diseases carrying compensation, but who persisted in blaming the work for their illness Two men in particular illustrated the unfortunate results which well-meaning people, doctors as well as laymen, may produce by encouraging such an attitude One of these men was an arc welder with siderosis, and the other operated a grinder in a machine shop and now has pulmonary tuberculosis Neither had valid ground for claiming compensation, but both had been encouraged to embark on litigation and to fight losing battles until they had become so obsessed with their grievances that they were permanently unemployable

In the present series, which contained a high proportion of intelligent and stable men, compensation claims had no adverse emotional effects, provided that they could be settled quickly and definitely It was noticed that a successful claim often improved morale without removing the incentive to get back to work Men seemed to feel

that any implication of personal failure in becoming ill was removed if responsibility for their breakdown was admitted by the industry, and they also felt that to some extent at least justice had been done The men with chronic bronchitis often believed that their trouble must really be caused by the dust, and they felt that they were unjustly treated because they could not claim compensation, or continue to receive free coal, or remain indefinitely in their tied colliery houses, as the men with pneumoconiosis normally could Emotional disturbances which resulted from physical incapacity and were severe enough to affect the men's behaviour and to throw added strain on their wives and families were seen in five men with chronic bronchitis and one with pneumoconiosis It is a tribute to the tough moral fibre of the group as a whole that these were the only men affected to such a marked degree The most impressive finding was the resilience with which so many men disabled by one or other of these diseases made the best of extremely unpleasant situations Whenever it was possible to help them we felt that they were particularly well worth helping because they did so much to help themselves

Twenty per cent of the patients needed casework, and this usually involved one or more visits to their homes, and sometimes visits to employers as well Fifteen per cent needed simpler forms of help, but the rest could manage their own social and industrial affairs, and only needed advice and information

Discussion

The main medical and social problem in this hundred patients is the emphysematous and dyspnoeic coal miner, with pneumoconiosis and chronic bronchitis as the chief associates of the emphysema Acute carbon monoxide poisoning and psychological disease form two equally common groups The three cases of lead poisoning and the single case of chrome ulceration of the nasal septum related in each case to small factories (which were visited) with low standards of environmental hygiene A diagnosis of pneumoconiosis in a man who was not severely disabled was more serious socially than one of chronic bronchitis, because such men were legally prevented from working underground or in any work in coal mining, apart from a few non-dusty, surface jobs This often meant forced unemployment because in a pit village mining is the only available work More elastic legislation combined with the establishment and dispersal of light employment (other than coal mining) in the villages, as well as in any new towns which may be built, will considerably lessen the social effects of chronic chest disease in coal miners in this area

Both the medical and social results of industrial illness differ only in points of detail from other medical diseases, and successful management, as opposed to the narrower conception of "treatment," stands or falls with the unity of the medical and social team, and with the success of this team in securing the co-operation of the patient and of his home environment

The amount of work involved in social management depends not so much on the severity of the problems as on their complexity A single difficulty can often be dealt with by simple means Reference to public assistance (or the Assistance Board as it would be now), a letter to an employer, even a full discussion with the patient and some advice or information, may be all that is needed to prevent serious trouble In a complex problem a number of separate difficulties react on one another in such a way that the treatment of any one of them must take into account its effect on all the others It is not sufficient here to refer the patient to one or more of the official bodies concerned with particular forms of help, such as financial assistance or rehabilitation If there is a chance of improving the situation, it can only be done by the individual approach and intensive methods of social casework

Close integration of clinical and social work made it possible for the patient's management always to be considered as a whole, and there was no risk that the patient would be given conflicting advice by clinician and social worker It was much more difficult to continue this integration outside the hospital walls However suitable the plan of action which clinician and social worker helped the patient to evolve, it might miscarry from the start unless it also had the approval of the patient's family, his employer, his trade union officials, and his private doctor To secure this was a task which sometimes required much time and patience

To compare the clinical practice with the precept (Browne, 1947), less home visiting has been necessary than was originally visualized, and when assessing physical hazards to health it has been found better that the clinician should do any industrial field visits either himself, or with the social worker, rather than that the latter, with her essentially non-technical background, should go alone She does, however, visit employers independently to discuss with them the resettlement of patients whose working conditions are already known No difficulties have been encountered in visiting either homes or works, and this may be ascribed to the fact that the visitors are representatives of an independent university department and have a therapeutic relationship with the patient

SUMMARY

The medical, social, and industrial problems of the first hundred patients of a university department of industrial health are described

Sixty-nine per cent of the patients were coal miners, and the remaining 31 per cent covered a wide range of occupations

One-third of the coal miners seen had chronic bronchitis and emphysema, and about another third had pneumoconiosis Carbon monoxide poisoning and psychological abnormality were the next commonest diagnoses

The social pathology varied directly with the length of the illness and with the disability caused Loss of earnings, together with the difficulty of obtaining lighter work, were the two most important social findings

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MORTALITY AMONGST BABIES FROM INJURY AT BIRTH

BY

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Much has been said and written about infant mortality and particularly about its decline Even statesmen have cited its decrease as suggestive evidence of the benefits which arise from their stewardship They are, it would seem, oblivious of the fact that the decline is not of recent occurrence but one which has been operating over a period of many years The facts are easy to appreciate Fifty years ago the mortality in infancy in England and Wales exceeded 150 per 1,000 births, in 1948 it was 34, an impressive reduction which was particularly observable in the age group 3-12 months The reduction in the first four weeks of life has been less satisfactory

It may well be asked whether each contributory cause of death in early infancy has declined equally or whether some have declined more than others If the average annual change in the mortality "under 4 weeks" during the period 1931-38 is expressed as a percentage of the mean death rate in that period in England and Wales, the statistical picture for certain broad categories is as in Table I

It will be noted that in four instances the mortality has declined, the annual decrement being largest (9 1 per cent) for convulsions The death rate in the two remaining groups, congenital malformations and injury at birth, increased, and the increment for the latter was the greater as the values were 1 1 per cent and 2 6 per cent respectively It should be stated, however, that there is a school of expert medical opinion which regards such observed increments as fictitious Although it recognizes the total neonatal mortality as a reliable figure, it suggests that the constituent causes defy statistical analysis owing to the inability of doctors in general to state, with any degree of precision, the exact cause of death at this period of life The difficulties of accurate certification of causes of death in the first four weeks of life are well recognized, but it would seem unlikely that medical men are in the habit of exaggerating birth injury as a cause Indeed, the joint report of the Royal College of Obstetricians and Gynaecologists and the British Paediatric Association (1949) has suggested a much higher rate of mortality from birth injury than is revealed by the Registrar General's tabulations

It is not the province of a statistician to question the validity of medical diagnosis In the absence of a sudden or startling departure from the normal mortality (apart from epidemic experience), he accepts the declared findings as facts although he is, at the same time, fully conscious of the vagaries of medical opinion and the influence of new precisions on diagnosis We have been told, however, that the increments which have been demonstrated in the mortality from injury at birth may possibly be due to a transfer of deaths from asphyxia, atelectasis, or convulsions The death rate from convulsions has declined, and convulsions in children under four weeks are believed, in many instances, to be the aftermath of an injury during delivery As a test we calculated the mortality of a combined group of causes of death, namely convulsions, injury at birth, asphyxia, and atelectasis, over a

TABLE I

AVERAGE ANNUAL CHANGE IN MORTALITY "UNDER FOUR WEEKS" EXPRESSED AS PERCENTAGE OF MEAN DEATH RATE

	Convulsions	Congenital malformation	Congenital debility	Premature birth	Injury at birth	Other causes
Mean death rate under 4 weeks per 1,000 live births	0 89	3 65	1 52	16 02	2 30	6 28
Percentage annual increase or decrease	−9 1	+1 1	−6 7	−1 9	−2 6	−1 3

period of years In 1945 approximately 4,000 deaths of babies under one month were ascribed to this causal group If it can be shown that the mortality from this combination has increased, then there is little basis for suggesting that a transference of deaths affords an adequate explanation. The death rates at ages under four weeks per 1,000 births were as in Table II for (A) the combined group, and (B) the residual neo-natal mortality

TABLE II

DEATH RATES UNDER FOUR WEEKS PER 1,000 BIRTHS
A COMBINED B RESIDUAL

Period	A	B
1921-30	5 03	27 53
1931-39	5 20	25 48
1945	5 55	19 21

It will be seen that the death rates in (A) differ from those in (B) in their movement, if anything, they indicate a slight increase in their secular trend In this connexion a comment by Martin is relevant

A matter for concern is the steady rise in deaths due to injury at birth, from 1 22 in 1920 to 2 59 in 1938 A similar trend has been shown by the United States where the mortality from injury at birth rose from 3 9 in 1920 to a peak of 5 3 in 1930 and then declined slightly to 4 8 in 1939

It is not possible to obtain an inclusive rate for the three causes of death in the main geographical regions of England and Wales over a long series of years, as deaths from asphyxia and atelectasis were not published separately for each area until 1940. Accordingly the combined rate for convulsions and injury at birth under four weeks was calculated and is set out in Table III

TABLE III

COMBINED DEATH RATE FOR CONVULSIONS AND INJURY AT BIRTH

Area	Average death rate in period 1931-45
Greater London	2 48
South-Eastern Counties (outside Greater London)	2 52
North I	3 97
North II	3 41
North III	3 35
North IV	3 46
Midland I	3 05
Midland II	2 93
East	2 66
South-West	3 00
Wales I	4 19
Wales II	4 65

The following list enumerates the counties grouped in Tables III and XII

SOUTH EAST
Bedfordshire
Berkshire
Buckinghamshire
Essex
Hertfordshire
Kent
London
Middlesex
Oxfordshire
Southampton
Surrey
Sussex, East
Sussex, West
Wight Isle of

NORTH I
Durham
Northumberland

NORTH II
Cumberland
Westmorland
Yorkshire E. Riding
Yorkshire N Riding

NORTH III
Yorkshire W Riding
York (County Borough)

NORTH IV
Cheshire
Lancashire

WALES I
Brecknockshire
Carmarthenshire
Glamorganshire
Monmouthshire

MIDLAND I
Gloucestershire
Herefordshire
Shropshire
Staffordshire
Warwickshire
Worcestershire

MIDLAND II
Derbyshire
Leicestershire
Northamptonshire
Nottinghamshire
Peterborough Soke of

EAST
Cambridgeshire
Ely Isle of
Huntingdonshire
Lincolnshire—
Parts of Holland
Parts of Kesteven
Parts of Lindsey
Norfolk
Rutlandshire
Suffolk East
Suffolk, West

SOUTH WEST
Cornwall
Devonshire
Dorsetshire
Somersetshire
Wiltshire

WALES II
Anglesey
Caernarvonshire
Cardiganshire
Denbighshire
Flintshire
Merionethshire
Montgomeryshire
Pembrokeshire
Radnorshire

The lowest rate was 2 48 in Greater London, and the highest was 4 65 in Wales II (North Wales) The large geographical differences in Table III and the suggested increment in the mortality in recent years (Table II) would seemingly indicate that injury at birth is a problem meriting attention The number of deaths ascribed to this specific cause is not unimportant, as in 1945 in England and Wales the deaths of 1,785 babies under four weeks were specifically ascribed to injury at birth Furthermore, on page 33 of report No 94* on *Neo-Natal Mortality and Morbidity* it is stated "Most observers agree that one of the leading causes of death in the first four weeks of life is injury at birth" For this reason it seemed desirable to study the available statistics in the hope that some light might be shed on this aspect of the mortality of infancy Such is the purpose of the present investigation

VARIATION IN RATES OF MORTALITY

In 1940 the Registrar General began the tabulation of deaths from injury at birth under one year in each administrative county and in each county borough

* Report by a joint committee of the Royal College of Obstetricians and Gynaecologists and the British Paediatric Association (1949) His Majesty s Stationery Office, London

TABLE IV

MEAN DEATH RATE FROM INJURY AT BIRTH UNDER ONE YEAR

Area	Mean death rate under 1 year per 1,000 births	Coefficient of variation
Administrative counties	2 57	21
County boroughs	2 63	30

in England and Wales Accordingly, it is possible to obtain a picture of the variation in the mortality throughout the country The mean rate based on the statistical experience of 1940-43 with the inclusion of 1945 (the report for 1944 is not yet published) in areas with at least 5,000 live births during these five years and the relative percentage dispersion (coefficient of variation) around the mean rate (unweighted) were as in Table IV

The death rate in the large towns is slightly greater than that in the administrative areas, and in both there is an appreciable dispersion in the mortality, the scatter (coefficient of variation) being relatively greater in the former than in the latter The actual range in the mortality in the county boroughs was from 1 35 to 5 74 per 1,000 births and in the counties was from 1 47 to 3 98 Examples of high and low death rates per 1,000 live births are set out in Table V

counties (Reading and Oxford) is revealing (Table VI)

TABLE VI

DEATH RATE UNDER ONE YEAR FROM INJURY AT BIRTH AND NEO NATAL DEATH RATE OF OXFORD AND READING

Area	Death rate under 1 year from injury at birth per 1,000 live births	Neo-natal death rate* (excluding injury at birth) per 1,000 live births
Oxford	2 68	15 0
Reading	2 18	23 2

* As it was not possible to obtain the death rate from injury at birth for the age period 0-4 weeks for each administrative county, each county borough and each metropolitan borough, the rate from injury at birth at 0-12 months has been subtracted from the total neonatal mortality This is a legitimate step since over 95 per cent of the total deaths from injury at birth in England and Wales occur during the first four weeks of life Hence it will be understood that in this paper the residual neonatal mortality equals the neonatal death rate from all causes minus the death rate from injury at birth at 0-12 months

The death rate from injury at birth in Oxford is 23 per cent in excess of that in Reading, whereas the neonatal rate is 35 per cent in defect The explanation of the divergence may be that in Oxford there is more accurate reporting, due to the teaching and team work of the obstetrical unit at the Radcliffe Infirmary, or that the social structure of the population of Oxford is, on the average, better than that of Reading and, as will be shown later, the mortality from injury at birth is correlated with

TABLE V

MEAN DEATH RATE FOR INJURY AT BIRTH

County boroughs				Administrative counties			
High		Low		High		Low	
Huddersfield	5 74	Merthyr	1 98	Anglesey	5 23*	Kent	1 99
Blackpool	5 03	Barrow	1 66	Brecknock	3 98	Notts	1 79
South Shields	4 51	East Ham	1 62	Caernarvon	3 83	Berks	1 76
Burnley	3 90	West Ham	1 35	Oxfordshire	3 26	Flint	1 47

* Rate based on less than 5 000 births

The towns reveal a striking contrast East Ham and West Ham, overcrowded East London boroughs, are at the bottom of the list, and Huddersfield and Blackpool, two towns differing considerably in their social and occupational environment, are at the top In the administrative counties an equally striking comparison is evident. Oxfordshire, which invariably has one of the lowest rates from infant mortality, has a rate from injury at birth nearly double that of the contiguous county of Berkshire The contrast between the county boroughs in these two social class, the death rate being greater among the higher than among the lower social groups of the population in England and Wales

GEOGRAPHICAL DISTRIBUTION

In view of the disparity revealed by the foregoing comparisons, it was of interest to obtain a picture of the statistical importance of the mortality in the geographical counties of England and Wales, the geographical county being the administrative county including its county borough For this purpose it

was deemed more satisfactory to compare the actual and calculated deaths, the "expected" or "calculated" deaths being deduced from the average statistical experience in the aggregated administrative counties and in the aggregated county boroughs respectively An example will elucidate the procedure

In the aggregated administrative counties of England and Wales the weighted average death rate under one year from injury at birth during the five years 1940-43 with the addition of 1945,* was 2 50 per 1,000 live births and in the aggregated county boroughs 2 75 Hence in the administrative county of Warwick, in which there were 38,508 live births during the period, the number of "expected" deaths from injury at birth would be

$$\frac{38{,}508 \times 2\ 50}{1{,}000} = 96$$

Similarly in the county borough of Warwick the expected number would be

$$\frac{112{,}495 \times 2\ 75}{1{,}000} = 309$$

Hence the calculated number of deaths from injury at birth in the geographical county would be

$$96 + 309 = 405$$

Finally the statistical significance of the difference between the actual and calculated number of expected deaths in each geographical county was estimated from the formula

$$\frac{\text{Actual deaths—Expected deaths}}{\sqrt{\text{Expected deaths}}}$$

and the results are depicted in Fig 1 in which the shadings indicate counties with mortality significantly in excess, moderately in excess, moderately in defect, and significantly in defect An example may help to facilitate its interpretation

The difference in Warwickshire is positive, and, since it exceeds twice its standard error, it indicates an excessive number of deaths in this county On similar reasoning the mortality in Berkshire is significantly in defect of what would be expected from the general average

There is no definite belt or region of high mortality The "black spots" are widely separated Suffolk and Warwickshire in England, Pembroke, Caernarvon, Anglesey, and Denbigh in Wales It is surprising to discover in Lancashire, where the infant mortality is invariably excessive, that the number of deaths from injury at birth is subnormal The general picture in Fig 1 certainly lacks the definition presented by Fig 2, which relates to the disposition of the neonatal deaths excluding injury at birth Here it will be observed that there are two distinct zones of excess and defect and the line of demarcation is from the Humber basin to that of the Severn To the east of this line, including the counties of eastern and southern England generally, the mortality is low, whereas to the west and north the death rate is excessive In view of this apparent dissimilarity in the geographical alignment of the two variables—injury at birth and the residual neonatal mortality—it was of interest to obtain a picture of the geographical distribution of the maternal mortality (Fig 3) In it there are three black areas one represented by Northumberland, Durham, and the North Riding of Yorkshire, the second, by Pembroke and Glamorgan, and the third, by Devonshire In other respects the main features of this map are not unlike those outlined in Fig 2

A pictorial presentation based on the geographical county has an attraction, since it enables a quick impression to be gained, yet if one desires to make a precise comparison, the county as a unit may possibly be too large and so help to depress aspects inherent in the statistics of the large towns For this reason it was resolved to evaluate the correlation coefficients between the three variables (1) injury at birth, (2) neonatal mortality (excluding injury at birth), and (3) maternal mortality in those county boroughs and administrative counties which had more than 5,000 births during the five years Partial correlation coefficients were also calculated

* The figures for 1944 are not yet available

TABLE VII

DEATHS FROM INJURY AT BIRTH IN WARWICKSHIRE AND BERKSHIRE

	Actual No	Expected No	Difference	Standard error of difference
Warwickshire	466	405	61	3 03
Berkshire	57	78	—21	—2 38

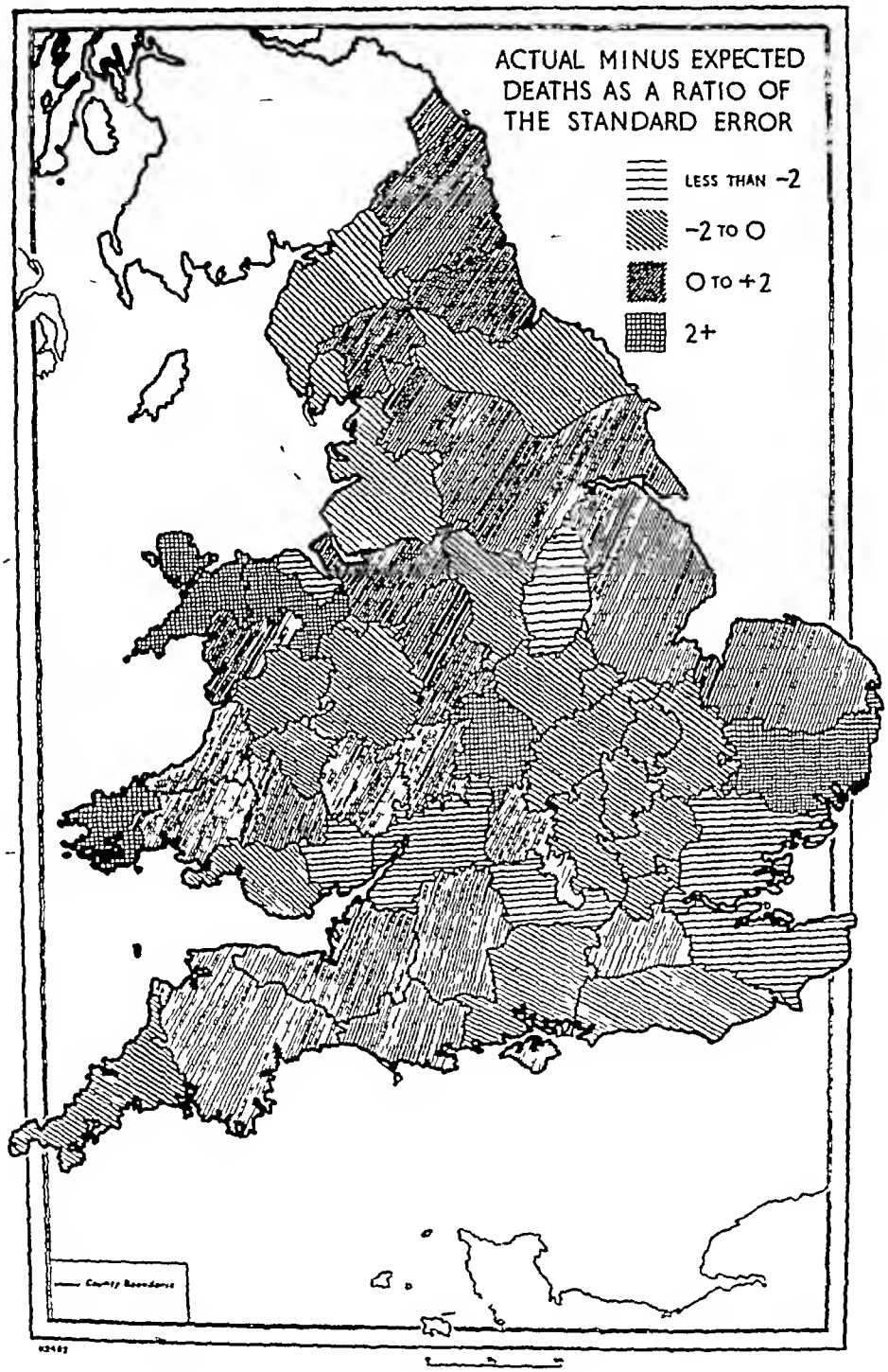

FIG 1.—Map showing geographical incidence of injury at birth

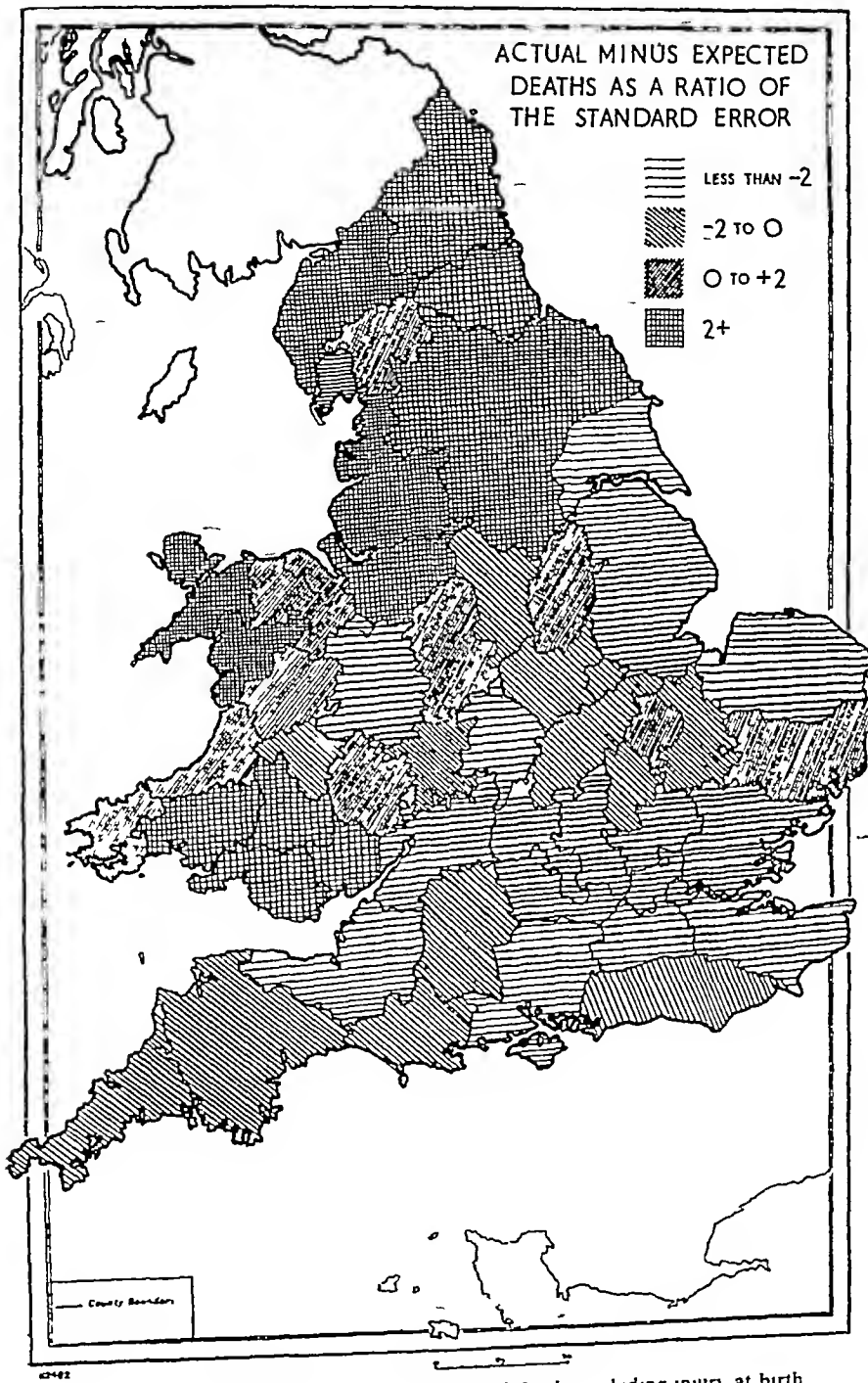

FIG 2.—Map showing disposition of neonatal deaths excluding injury at birth

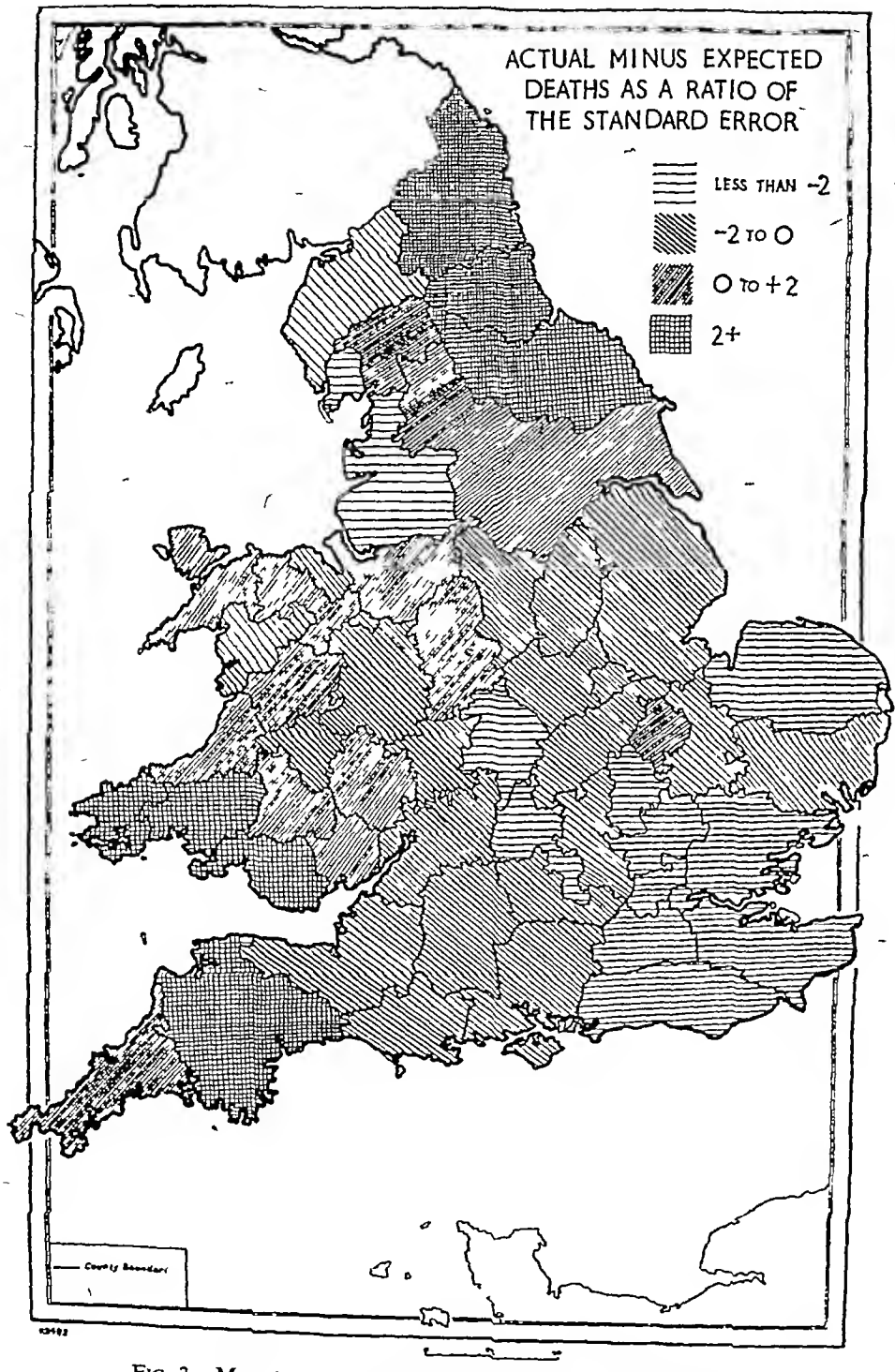

FIG 3—Map showing geographical distribution of maternal deaths

These measure the correlation between two of these variables when the effect of the third is eliminated The results were as follows —

Administrative counties (52)

r12=+ 072	r12 3=— 014
r13=+ 136	r13 2=+ 166
r23=+ 614*	r23 1=+ 621*

County boroughs (72)

r12=+ 233†	r12 3=+ 193
r13=+ 143	r13 2=+ 057
r23=+ 399*	r23 1=+ 379*

* Statistically significant † Borderline significance

It will be noted that there is only a very small correlation between injury at birth and either the neonatal or maternal mortality In other words, the factors which play a part in determining the mortality from injury at birth are relatively unimportant so far as the residual neonatal (dominated, of course, by prematurity) and maternal mortalities are concerned On the other hand the correlation between the neonatal mortality and maternal mortality is substantial, particularly in the administrative counties, where the partial coefficient is + 621 Hence one can safely conclude that towns or administrative counties which have a high death rate from injury at birth do not necessarily have a proportionately high neonatal mortality

London

Since more births occur in hospital in London than in other parts of the country, a separate analysis was made for the 28 metropolitan boroughs The correlation between the three variables was as follows —

r12=+ 266	r12 3=— 033
r13=+ 482*	r13 2=+ 438†
r23=+ 520*	r23 1=+ 481*

* Statistically significant † Borderline significance.

The results for the London boroughs confirm those in the county generally in as much as the partial coefficients indicate the dissociation between the mortality from injury at birth and the neonatal death rate, and the positive relationship between neonatal and maternal mortality

They differ, however, in one aspect, because there is evidence that there is a fairly definite relationship between injury at birth and maternal mortality, the partial coefficient being + 438 What is the explanation of this ? Can it be that there is more surgical interference in deliveries in hospital, or is it simply that a high proportion of difficult cases are delivered in hospitals ?

Possible Causes

In view of the suggested increase in the mortality from injury at birth in England and Wales generally since 1921, it is cogent to consider the possible causes under three headings

An Increasing Proportion of First Births —These are generally accepted as being more difficult than subsequent deliveries If this is so there should be a positive correlation between the rate from injury at birth in an area and the proportion of first births there It is possible to obtain a crude answer on this aspect because the Registrar General has published data showing the proportion of first births in the 12 major divisions of England and Wales Correlating these ratios for the period 1940-42 with the corresponding death rates from injury at birth, the coefficient was found to be r= – 0 201, a result which is statistically insignificant.

Significance of Hospital Deliveries —In London, approximately 80 per cent of the total births occur in institutions, as compared with approximately 20 per cent in the remainder of the country The corresponding rates of mortality from injury at birth are 2 48 and 2 56 per 1,000 births respectively In view of the disparity in the proportion of births which occur in hospitals in London compared with the rest of the country and the approximate equality in the rates of mortality (assuming that the data are comparable in all other respects) it would seem that birth in hospital is an ineffective factor in preventing death from injury at birth It may, of course, as has been suggested, be argued that the more difficult cases are now usually removed to hospital for delivery It is perfectly true that difficult cases are referred to doctors by midwives but, as regards delivery in hospital in London the greater part of the enrolment is made early in pregnancy before a prognosis is possible, excepting in so far as anatomical abnormalities in the mother are recognizable in a proportion of cases

Instrumental Delivery —There has been an increasing tendency in recent years to have recourse to instrumental delivery There are no specific statistics to support this statement, but the contrast of the mortality rates according to social status may act as a pointer

According to the statistics compiled for the period 1930-32 by the Registrar General the death rate from injury at birth and the residual neonatal mortality in three broad social groups in England and Wales in the period 1930-32 was as set out in Table VIII

It will be noticed that with descent in the social scale the mortality from injury declines, whereas for the residual neonatal mortality there is an

TABLE VIII

COMPARISON OF DEATH RATE FROM INJURY AT BIRTH AND RESIDUAL NEONATAL MORTALITY IN THREE SOCIAL GROUPS

Classes	Legitimate births	
	Injury at birth under 1 year per 1,000 live births	Neo-natal mortality (excluding injury at birth) per 1,000 births
I and II (professional and administrative grades)	2 44	23 9
III (skilled workers)	2 13	27 3
IV and V (semi-skilled and unskilled labourers)	1 96	30 3

increase Obviously different agencies operate to produce this divergency

Further evidence of the pattern made by social class is revealed by the statistics of a more recent date When the boroughs of London are classified into two broad groups according to socio-economic status "good" and "poor", and the expected number of deaths is calculated for the quinquennial period 1940-43 (including 1945) and compared with those actually enumerated, the following results are obtained (Table IX)

TABLE IX

ACTUAL AND EXPECTED DEATHS FROM INJURY AT BIRTH IN LONDON BOROUGHS GROUPED ACCORDING TO SOCIO-ECONOMIC STATUS

District	Injury at birth		Difference
	Actual	Expected	Standard error of difference
Good	319	306	+0 74
Poor	204	221	−1 15

It will be seen that there is a tendency for the "good districts" to have a mortality in excess of the average and for the "poor" areas to be in defect, although in neither instance is the difference statistically significant The picture, while it is suggestive, is not as definite as is that for maternal mortality in the two groups (Table X)

In the "good" districts the recorded maternal deaths are significantly in excess of the number expected to occur, whereas in the poor areas they are statistically below expectation It may be argued that the correlation which has been indicated

TABLE X

ACTUAL AND EXPECTED MATERNAL DEATHS IN LONDON BOROUGHS GROUPED ACCORDING TO SOCIO-ECONOMIC STATUS

District	Actual	Expected	Difference
			Standard error of difference
Good	295	261	+2 10
Poor	158	192	−2 45

may possibly be due to a higher proportion of first births in the better class districts but this argument invites the question, Is injury at birth relatively more frequent amongst first births ? The available statistical evidence based on the Registrar General's returns, to which reference has already been made, offers no confirmation of this idea The correlation coefficient between injury at birth and the proportion of first births was statistically insignificant

AGE OF MOTHER

Since age is an important correlate of mortality statistics it may be asked to what extent the age of the mother is a dominant factor in the present instance Is injury to the baby at birth relatively more frequent among older than younger mothers, particularly if they are primiparous women ? The only available evidence on this aspect of the problem on a national scale was that relating to stillbirths in Scotland during the years 1939-45 The death rate ascribed to injury at birth among the babies in this series of observations when correlated with the age of the mother was found to be as recorded in Table XI

TABLE XI

DEATH RATE IN SCOTLAND FROM INJURY AT BIRTH IN STILLBIRTHS CLASSIFIED ACCORDING TO AGE OF MOTHER

Age of mother	Still births per 100,000 (live and stillbirths)
Under 35 years	90
Over 35 years	112

It would appear from these values that the age of the mother is a factor of importance This association invites the question Has there been an increase in the age of motherhood ? Unfortunately the relevant statistics are only available for a restricted period, because it was not until 1939 that the statistics of births in relation to the age of mothers were first published in England and Wales Comparing the mean age of legitimate maternities for first children in 1939 and in 1945 the values in the 12 major divisions were as in Table XII

TABLE XII

MEAN AGE OF LEGITIMATE MATERNITIES IN TWELVE MAJOR DIVISIONS OF ENGLAND AND WALES

Area*	Mean age of legitimate maternities (first children)		Difference
	1939	1945	
Greater London	26 8	26 9	+0 1
Remainder of South Eastern Counties	26 4	26 5	+0 1
North I	25 6	25 8	+0 2
North II	25 9	26 1	+0 2
North III	26 2	26 3	+0 1
North IV	26 6	26 7	+0 1
Midland I	26 3	26 5	+0 2
Midland II	26 3	26 2	−0 1
East	26 0	26 0	—
South-West	26 5	26 4	−0 1
Wales I	25 6	25 8	+0 2
Wales II	26 7	26 9	+0 2

* See Table III for details of areas thus grouped

It will be seen that in the majority of instances there has been an increase in the mean age, but it is not of sufficient moment to explain the ostensible increase in the mortality from injury at birth Furthermore, the mean age of mothers in Greater London is almost identical with that of Wales II (North Wales) There is, however, a wide difference in the mortality rates from injury at birth, as is indicated by the composite figures presented in Table III

SUMMARY AND CONCLUSIONS

In this study we have considered only fatal injuries at birth, as no data are available in connexion with the numerous residual disabilities resulting from non-fatal injury This analysis of the available statistics in England and Wales since 1921, and in various administrative counties and county boroughs including London, may be summarized as follows

There has been an apparent increase in the mortality during the period 1921-45 even when allowance is made for the transference of deaths from convulsions, asphyxia, and atelectasis

There are large differences between the mortality rates in the various administrative counties, and likewise between the county boroughs

Contrary to expectation, there is little correlation between the mortality from injury at birth and the proportion of first births in the 12 major regions of England and Wales

There is evidence from Scottish data on still-births that the mortality ascribed to injury at birth among them depended upon the age of the mother, the death rate being higher amongst older women There are no available statistics in England and Wales which relate the age of the mother to the mortality from injury at birth Statistics of the age of maternity have been published since 1939 and have indicated a slight increase in the mean age between 1939 and 1945 throughout the country It is very doubtful, however, if this increase is sufficient to account for the suggested increase in the mortality

The mortality in a group of " poor " boroughs in London is subnormal, whereas in a " residential " group it is in excess of the average for London There is also a positive correlation between the mortality from injury at birth and the maternal death rate This may or may not be the result of undue surgical interference

The evidence presented would seem to indicate the reality of the problem, but complete proof of its existence, and, if it does exist, of its solution, can be determined only by a carefully planned specific study

The need here demonstrated for such a study has recently been emphasized in the following statement from the Report on Neonatal Mortality and Morbidity

> Many cases of birth injury are undoubtedly due to lack of obstetrical skill and judgement on the part of the accoucheur especially when delivery by breech or by forceps has been necessary

ABSTRACTS

(This section of the JOURNAL *is devoted to selected abstracts of articles on social medicine appearing in the current literature The section will be edited in collaboration with the two abstracting Journals,* Abstracts of World Medicine, *and* Abstracts of Surgery, Obstetrics and Gynaecology)

A Genetical Study of Human Mammary Cancer PENROSE, L S , MACKENZIE, H J , and KARN, M N (1948) *Ann Eugen , Camb ,* 14, 234

The role of hereditary factors in the aetiology of cancer is most easily recognized in the case of mammary cancer because the latter is more accurately diagnosed than malignant growths at most other sites Furthermore in the great majority of instances such tumours produce a clearly defined range of pathological conditions

The history of investigations into the genetic aspects of mammary cancer was summarized by Jacobsen in 1946 In spite of the evidence brought forward by a great many investigators that mammary cancer frequently affects several related females in a pedigree doubt still remains whether hereditary factors play any significant part in its causation This uncertainty derives from the fact that this particular disease is very prevalent in the population as a whole, being responsible for nearly 3% of all deaths in females It is thus difficult to demonstrate that any familial concentration is not merely the result of a random distribution of cases

In the present study a direct comparison is made of deaths from different types of cancer in the relatives of a series of propositae with the rates for the population as a whole The material was compiled in such a way that if the results did show definite evidence of hereditary transmission indications of the type of inheritance could also be obtained Particular attention was paid to the possibility of transmission through maternal milk All patients suffering from mammary cancer and attending a clinic were personally interviewed and family histories including those of patients' parents, brothers, sisters, children, grandparents, uncles, and aunts were compiled, 510 cases of mammary cancer in females being collected In 144 instances a relative suffered from cancer of some type and in 118 instances one or more relatives had mammary cancer The mean age of the patients when first interviewed was 55 2 years and they had on the average lived 3½ years since the first signs of the disease had been recognized, 255 were affected first on the left side and 253 on the right side In the rest there was some uncertainty on this point Of the mothers of these propositae 25 had died of mammary cancer and 51 other mothers had died of some other form of malignant disease At the time of the investigation 104 mothers were still living and of these 6 were known to be suffering from mammary cancer No similarity between age of onset of breast cancer in the mothers and age of onset in the propositae could be demonstrated Some 365 sisters of the propositae had died, 23 of mammary cancer and 19 of other types of malignant disease

There was thus a highly significant increase in observed deaths from mammary cancer amongst these sisters but no significant divergence from expectation as regards deaths from other types of malignant disease Amongst 890 sisters still living at the time of the investigation 24 were under treatment for breast cancer and 7 for other types of malignant disease Only one death due to mammary cancer was found amongst the male relatives Amongst the propositae were 410 married women who had had 387 liveborn sons and 398 liveborn daughters together with 28 stillbirths The group of propositae was therefore slightly less fertile than the general female population from which it was drawn The daughter of one proposita was found to be suffering from mammary cancer and 2 sons of 2 others had died of malignant disease

There emerged from this study, therefore, a strong suggestion that transmission of a specific genetical factor is a major cause of mammary cancer The familial incidence amongst sibs, however, was not sufficiently high to suggest any simple Mendelian explanation of the inheritance The search for evidence that mammary cancer in the human female was being inherited through maternal milk gave equivocal results, no significant association being found between patients who were breast-fed in infancy and those in whose families there was concentration of the disease in the maternal relatives

F A E Crew

A Statistical Report on 2,529 Cases of Cancer of the Breast HARNETT, W E (1948) *Brit J Cancer,* 2, 212

A statistical study is made of 2,152 primary and 377 recurrent carcinomata originating in the breast The civil state and age distributions are first shown and compared with those in Lane-Claypon's series As the author s data include recurrences, the mean ages are higher than those in Lane-Claypon s report which dealt with patients coming to hospital for operation It appears that the interval between recognition of first symptoms and consultation of a doctor was more than 6 months in 40 6% of the patients Rather fewer than a quarter of the patients, 24 3%, had growths in clinical stage I, namely, growth confined to breast, no involvement of axillary lymph nodes, and no infiltration of skin or muscles Of patients with stage-I growths treated by radical mastectomy (236) 68 2% of those traced survived 5 years Of those treated by radical mastectomy combined with radiotherapy (69) the percentage was 64 1 Detailed tables, too numerous for abstraction bring into account age, duration of symptoms and other factors There is an elaborate and valuable tabulation of survivorship in which are shown the mean actual survivorship, the expected survivorship (from English Life Table No 10), and the maximum possible for 5 years (60 months) This is undoubtedly the right method of analysis The conclusion emerges that the 5-year expectation of life after radical mastectomy ranges from 91 03% of normal in stage I down to 68 4% in stage IIIb (growth infiltrating skin or muscle or both, and axillary lymph nodes involved)

(It is to be hoped that a similarly detailed analysis will be made of data covering a further range of years

inevitably, sub-tabulation of even so long a series as this ends in small numbers the statistical interpretation of which must be difficult The paper is, however, an important one) *Major Greenwood*

Childbearing in the Twilight of the Reproductive Period DAVIS, M E, and SESKI, A (1948) *Surg Gynec Obstet*, 87, 145

The authors point out that the function of childbirth is a function of youth and not of middle age They submit a statistical survey of childbearing in all women of 40 years or over confined in the Chicago Lying-in Hospital during 1927-1944 This comprises 1,011 patients out of a total of 52,128 (1 94%), 16 8% of the 1,011 were primigravidae Among the parous patients, an interval of 10 years or more had elapsed since the previous child in 18% The incidences of various complications of pregnancy were studied in the 1,011 patients and compared with the general figures for the hospital Abortion, placenta praevia, and toxaemia of pregnancy were all commoner The actual figure for the last-named was 24%, compared with 7 1% A higher proportion than usual was delivered by Caesarean section (13 3% against 4 4%) This difference is partially accounted for by a rate of 31 5% in elderly primigravidae, although the rate in multiparae (9 5%) was also above the usual figure The Caesarean section rates for dystocia and disproportion did not differ materially in the two series, the increase in abdominal delivery being due chiefly to the increase in pregnancy toxaemia and ante-partum haemorrhage in the older group In those delivered vaginally, the proportions in which delivery was completed by the natural forces were approximately equal, but among forceps deliveries there were relatively more mid-forceps deliveries than low forceps in the elderly patients There was a striking increase in breech presentation (7 4% in primigravidae and 5 4% in multiparae, against 4 4% for the hospital) The weights of the children showed a wider scatter in the older patients, with an increase in the numbers of very large children and also of premature infants Six mongols were recognized whilst in hospital Foetal deformities were present in 2 7%, against 1% The total foetal mortality rate was 9 5% compared with 3 5% Four mothers died, all before 1931 By present day standards, the authors consider that three of these deaths should have been avoided

They conclude that their figures indicate a definite increase in the hazards for mother and for child, but emphasize that these figures do not reveal the whole story, and that they do not include evidence of the recovery of the women and their babies after delivery Their impression is that the middle-aged mothers recover more slowly and are more likely to have persistent minor complaints, but, on the other hand, they have been impressed with the rejuvenating effect of motherhood upon some of their patients They have not been able to evaluate the remote prognosis for the mother who develops serious complications of pregnancy and labour *W I C Morris*

Abortion as a Factor in Sterility (L aborto quale fattore di sterilita) NOBILE, T (1948) *Ginecologia, Torino*, 14, 528

Study of the case records of 2,000 women treated in the Sterility Clinic at Turin during the years 1939-1944 leads to the conclusion that abortion is an important factor in sterility, 204 women were sterile after abortion and of these 75% had had only one abortion Premarital abortion was verified in 14%, 12% had had a febrile abortion The period of infertility after the abortion varied from 1 year to 15 years, but 25% of patients attended the clinic within the first 2 years after abortion Clinical signs of tubal infection were present in 23 5% Out of 60 women examined radiologically there was evidence in 52% of tubal occlusion not suspected on clinical examination Evidence that even a single abortion can cause sterility is given by the fact that 132 out of the 204 patients were aged from 25 to 35, normally the period of maximum female fertility Apart from subsequent infection, abortion causes serious disturbance of function, while psychological factors are also probably of importance *Josephine Barnes*

Observations on the Problem of Perinatal Mortality (Příspěvek k otázce perinatální umrtnosti) VÁCHA, K (1948) *Čsl Gynaek*, 13, 264

The author discusses the causes of stillbirth and of neonatal mortality in the Obstetrical Department at Usti, Czechoslovakia, in 1946 and 1947 The causes of infant death are divided into 15 groups Debility in the premature infant was responsible for the largest number In 1947 prematurity accounted for 73% of the stillbirth and neonatal death rate If we deduct these infants we get the relative death rate of 1 8% From this the author comes to the conclusion that the infant death rate does not depend so much on the conduct of labour in obstetrical institutions, but that it could be considerably lowered by improving antenatal care —(Author s summary)

Further Observations on the Medico-Social Aspect of Venereal Diseases MACFARLANE, W V (1948) *Publ Hlth, Lond*, 62, 4

The Venereal Diseases Department at the Newcastle General Hospital is computed to serve a population of approximately 1,000,000 New cases of syphilis seen at the clinic totalled 798 in 1927, 350 in 1932, 390 in 1937, 720 in 1942, and 583 in 1947 The number of patients suffering from gonorrhoea who attended in the same years was 1,070, 859, 932, 874, and 1,033, respectively The author stresses what he calls the medico-social unit " which, in addition to the chief and two assistant almoners and clerical staff working in the clinic, has 3 full-time and 3 part-time health visitors to undertake domiciliary visits

Of 2,855 patients interrogated by the unit only 58% gave reliable information concerning the contact, but 1,560 contacts were examined and 70% were found to have venereal disease The meeting places in the case of 1 000 contacts interviewed about the source of casual infection were public house (652) the streets (177), railway stations (95), dance halls (67), private houses, cinemas, cafes, coffee stalls ships and docks, brothels, theatres, hostels, and public parks In 32% of cases intercourse took place in the house of one or other partner and in 16% in brothels

The case records of 43 promiscuous women showed that 52% had previously been convicted in the courts and that 73% had intelligent quotients below normal At the time of examination 16 were working in factories 8 were in domestic service, 5 were waitresses, 4 were barmaids, 2 were shop assistants, and 8 did not work at all

Case holding is achieved by a combination of

personal letter and home visit, the latter has been found to be very successful, the ratio between successful and unsuccessful visits being 1 1 It is, however, considered that if there is no response after two visits and two letters little further can generally be achieved The corrected defaulter rates for male and female patients with syphilis and gonorrhoea vary from 6 to 13% Of 3,478 women who had defaulted for more than 2 years 2,032 were brought back to the clinic as a result of these measures, of male defaulters no less than 70% returned to the clinic after one or two letters only, but 36% were regarded as completely irresponsible The introduction of penicillin with its more rapid apparent cure, has led to a marked increase in default, 54% of patients default in the month immediately after treatment

(This clinic is one of the very few in Britain which publishes its statistics, and these are therefore read with considerable interest. It is idle to suggest that the continued high rate of new cases is no advertisement for the preventive measures of the area, because it can always be claimed that this is the result of better case-finding However, more attention might be paid to case-finding than to case-holding, which, in these days of penicillin therapy, can no longer be said to be a problem of public health proportions even if it is a pressing one for a few unfortunate individuals)

R R Willcox

The Health of Towns Association in Great Britain 1844-1849 An Exposition of the Primary Voluntary Health Society in the Anglo-Saxon Public Health Movement PATERSON, R G (1948) *Bull Hist Med*, 22, 373

At the present time, when health legislation is so widely discussed, it is interesting to recall the pioneer effort of the "Health of Towns Association" a century ago Founded by Dr Southwood Smith on December 11, 1844, the movement may be considered as the prototype of the many present-day health organizations in Great Britain and the United States This essay in health reform was one of many such efforts made in various fields about this time

At the end of the eighteenth century a virulent outbreak of typhus fever among the mill-workers of Manchester led to an investigation of their conditions and to the inception of various means to improve them Another powerful impetus to sanitary reform was the cholera epidemic of 1831-2 The close connexion between poverty and disease came into sharp focus A further step in advance was the registration of births, deaths, and marriages, which became effective in 1837

In 1838 Edwin Chadwick persuaded the Poor Law Commissioners to inquire into the physical causes of sickness and mortality, and the consequent reports acted as a stimulus to further effort Dr Southwood Smith, who had been an active participant in some of the earlier reforms, decided to take measures to influence the public and Parliament in the direction of health legislation The new association, which held its first meeting at Exeter Hall, London, was not a charity, but aimed at preventing the evils which charities endeavoured to palliate 'It would substitute health for disease, cleanliness for filth economy for waste, justice for charity' Provincial branches were soon formed One of the most active was that of Liverpool, which published a monthly periodical, *The Liverpool Health of Towns Advocate*, which appeared from 1845 to 1847 Support to the movement was also given by those who were at that time known as the working classes, and thus came into being, in London, "The Metropolitan Working Classes Association for Improving the Public Health" Among the objects of this association was the diffusion of information concerning the need for cleanliness, ventilation, drainage, and the importance of the nursing, feeding, and clothing of children

The work of the Health of Towns Association soon bore fruit, and in 1848 the Public Health Act was passed, embodying many of the ideals for which the association had striven The General Board of Health came into being, and instituted inquiries into the prevalence of infectious diseases, the disposal of the dead, water supplies, and other essential matters which concerned the public health The first President of the Board was Sir Benjamin Hall With the passage of the Public Health Act of 1848 the need for the association was no longer felt, and its activities ceased Nevertheless, the Health of Towns Association, during its brief career, began a process of health education which led to effective legislation The fruitful results of its work illustrate the importance of voluntary and unofficial efforts as a means of preparing the ground for the improvement of the general health of the community by well-directed laws

Douglas Guthrie

Socio-emotional Factors Accounting for Growth Failure in Children Living in an Institution FRIED, R, and MAYER, M F (1948) *J Pediat*, 33, 444

The authors, working at Bellefaire, the Jewish Children's Home at Cleveland, Ohio, claim that by using the Wetzel grid technique (a specially designed growth chart) they have shown that socio-emotional factors tend to affect physical growth adversely They also claim that psychiatric evidence and observations of behaviour, combined with medical findings on health, support their contention They believe that the best conditions of shelter, food, schooling, and medical and social supervision are in themselves insufficient to ensure normal growth in the presence of psychological disturbance

They claim that the grid technique, besides serving as a control chart on physical growth, has proved valuable in co-ordinating the work of the specialist workers—social workers, psychiatrists, paediatricians, nurses, and supervisors—at the home Quarterly readings of height and weight are part of the routine supervision of every child Failure to develop normally is taken as a signal for monthly observations, and also for a search for the cause, physical or psychological Two types of growth failure—simple nutrition and obesity—are recognized Children newly admitted show measurable growth failure (usually malnutrition) in 75 to 90% of cases Four case records are included, illustrating (1) prolonged initial adjustment, (2) delayed and intractable maladjustment, (3) recurrent failure, and (4) interrupted care, with recovery on a second admission

(Although the numbers of cases in this paper are too small to be of statistical value, they serve to emphasize that children being composed of psyche and soma, will, if chronically unhappy or unsettled, fail to develop physically as normally happy children would)

A T Macqueen

The Physical and Mental Development of Premature Infants A Statistical Survey with a Five-year Follow-up HIRSCHL, D, LEVY, H, and LITVAK, A M (1948) *Arch Pediat*, 65 648

Prematurity is still the chief cause of infant mortality Infants admitted to a nursery for premature babies

between 1942 and 1946 were studied Their weights at birth varied from 694 g to 2,000 g The mortality rate was 24 1%, and was higher for males than for females The death rate varied inversely with the weight groups of the babies The causes of death included cerebral haemorrhage, atelectasis, erythroblastosis foetalis, haemorrhagic disease of the newborn, intestinal obstruction, aspiration pneumonia, and bronchopneumonia The authors point out that the physical and mental development of these children is slightly delayed but is ultimately normal—for example, the males reach a normal weight by the end of 3 years and the females by the end of one year and they are all slower in walking and talking than are full-term infants

(In spite of recent advance in the care of premature infants the death rate has not decreased The very small babies weighing 1,000 g present the greatest problem Abrahamson has grouped the causes of mortality into diseases of the mother, duration of labour and obstetrical procedures, use of drugs in labour, disease of the baby, and after-care of baby It is emphasized that the obstetrician and the pediatrician have each their part to play in bringing about a decrease in the mortality rate)

B S P Gurney

Growth of the Preschool Child in London GORE, A T, and PALMER, W T (1949) *Lancet*, 1, 385

This investigation was undertaken to supply the medical officers of clinics with data on weights and heights of children under school age, until a comprehensive survey could be made of the country generally Measurements were taken in four London boroughs, and it is thought from evidence obtained of social conditions that samples representative of all London have been obtained The survey included 2,881 boys and 2,803 girls and the measurements were taken from records kept by the four borough medical officers In a table graduated mean weights are given and the authors state that data extracted from this table would be more useful for clinic work than a normal single curve of average weight (At one year the weight for boys is slightly below that of a 1940-2 Glossop survey (23 13 lb, 10 5 kg) and slightly above that of the girls in the Glossop survey (20 56 lb 9 3 kg)) Another table gives the actual averages of the measurements of height, but the authors consider the number measured (921) too small to be of any great value, however, as reliable height measurements are not readily available for very young children, the figures should prove useful (Workers in clinics will find these tables valuable for reference purposes)

E H M Milligan

The Recent Trend of Diphtheria in England and Wales MARTIN, W J (1948) *Mon Bull Min Hlth*, 7, 232

Before the introduction of widespread immunization, mortality rates from diphtheria in England and Wales fell from 888 per 1,000,000 children under 15 in 1901 to 301 in 1930 In 1940 the Government offered a prophylactic free to all local authorities Since then the mortality has decreased more rapidly than the incidence in 1946 deaths were 15% and notifications 30% of the pre-war levels As a cause of death at ages 1-5 diphtheria was the third highest in 1937-8 and sixth in 1945 at ages 5-10 it was first in 1937-8 and third in 1945 The decline in attack rate has not been uniform throughout the country London has had the most rapid fall, and the northern, south western, and west midland counties and Wales the least Urban districts show a slightly greater decline than rural There had been a change in the age distribution of notifications, and in 1947 the pre-school child and adult were relatively more often attacked than in 1944, whereas the attack rate for age group 10-15 was in 1947 one fifth of that in 1944 This is in direct contrast with the experience of preceding decades

A Michael Critchley

Job Performance of Physically Impaired Persons in Industry FELTON, J S (1948) *Occup Med*, 5, 466

The Oak Ridge National Laboratory employed 452 (11 1%) people with physical limitations The performance of 300 of these is compared with that of 300 normal controls The classification of applicants for work were as follows (1) any work, (2) any work, in spite of minor defects, (3) certain jobs, with specified restrictions of activity, and (4) no employment Those with limitations were 'placed' after reference to analyses of job requirements 59% fell into category (2) and 13% into category (3) Their performance was measured on the opinions of their supervisors, a separate rating being given for quality of work, quantity of work, knowledge of the job, adaptability, judgment, dependability, attitude, attendance, punctuality, and ability In the hope of getting greater objectivity, supervisors were given a standard form to complete in which reasons for each rating were set out

Each group comprised workers in many trades The groups were fairly comparable as regards age, sex, race, marital state, and length of employment The disabled men had all manner of abnormalities 32 6% had hernia An assessment of emotional adjustment, based on the answers given to significant items in a questionnaire consisting of 200 queries (Cornell Index) was made for comparison Accident rates also were compared The average scores of the two groups did not differ as regards punctuality, attendance, or attitude, but the quantity of work done appeared to be greater in the 'impaired' group, despite the variety of jobs while scores for ability and quality of work were rather better in the unimpaired The impaired workers had a slightly higher average Cornell Index (that is they had a greater tendency to neurosis) The physically normal group had a significantly higher accident rate, but the number of injuries per worker was the same in both groups The total scores suggest no significant difference between the job performance of the normal and impaired groups, nor between the larger subgroups of the impaired, for example those with cardiovascular disease hernia, or tuberculosis There was a low correlation between the Cornell Index scores and the supervisors ratings the former gives little indication whether or not a man is adjusted satisfactorily to his job The author concludes that these performances reveal the fallacy of applying rigid physical standards in industry and that disabled persons are valuable, productive and safe employees (Physical impairment and disability are confused here The former was determined at pre-employment examination and all varieties seem to have been included, regardless of whether a worker was handicapped in the job he was given Measurements of job performance take no account of individual workers problems Many workers left before their performance could be studied)

J N Agate

Some Notes on Suicide O'Connor, W A (1948) *Brit J med Psychol*, 21, 222

An explanation of suicide is worked out on the basis of Freud's theory of the conflict between Life and Death, Eros and Thanatos Eros is constantly active in maintaining life but there is at the same time a conflicting pull towards death and rest, and it is suggested that the longing for immortal life, which can only be reached by death, may belong to this side of the conflict The frequently observed calmness and complacency of a patient just before he commits suicide may be due to a solution of the conflict in favour of Thanatos Obviously church and state condemn suicide more fiercely than can be justified by the infinitesimal danger to the biological survival of the human race This condemnation is quite disproportionate when compared with the indifference of those institutions to poverty and disease The explanation of such official severity would seem to be the fear that individuals may too easily succumb to the demands of the death instinct, although this fear is inconsistent with the reverence for martyrs and monastic self-flagellators

The death wish is certainly not conscious but is deeply buried in the unconscious, and so it is only when the ascendency of the conscious mind is disturbed in severe mental illness that suicide is likely to occur In this state phantasy can become dominant and the wish may become a command. Suicide may become a certainty when the reality principle falls entirely into the background Until this happens real suicide is unlikely Reality worries are not usually responsible for suicide, and however devastating the vicissitudes of life may be it is doubtful if they should ever be looked upon as liminal stimuli for actual self-destruction The author quotes 18 cases which came under his own observation and considers that 90% of suicides had led an unsatisfactory sexual life and that 50% had homosexual tendencies

R G. Gordon

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Buzzard, Farquhar (1943) *Practitioner*, **151**, 129

Grotjahn, A (1923) *Soziale Pathologie*, 3rd edit., Springer, Berlin.

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J soc Med (1949), 3, 101-109

VISUAL TESTS OF FATIGUE IN OPERATIONAL FLYING

BY

D D REID

om the London School of Hygiene and Tropical Medicine University of London, and lately of the Directorate-General of Medical Services, Royal Air Force

The recurring problems in the medical supervision f men engaged in operational flying in the Royal ir Force were the optimum length of the tour of uty to be expected of them and the detection of the oint in that tour of duty when an individual was howing signs of impending breakdown The ength of the tour of duty had to be laid down as a general rule for each type of operational duty—whether fighter, bomber, coastal command, etc — and set at a level which obtained for the Service an adequate operational return for the training investment made and yet was compatible with the maintenance of health and morale Within the broad guide of this general tour limit, some latitude had to be allowed for individual variation Breakdown n any individual may be the result of some particularly harassing experience or the cumulative effect of stress on a man of less robust nervous constitution The release of a flying man from operational duty should anticipate complete breakdown but, if group morale is to be maintained, relief should not follow the appearance of slight deviations from normal function Few men survived an operational tour without showing some evidence of the effect of stress, whether symptomatic or objective, and it would have been unfair to relieve only those who brought these complaints to the squadron medical officer Occasions arose, too, where the squadron doctor was asked to state whether a man who was suspected, if not of malingering, at least of magnifying the physical and mental disturbances inevitable in air warfare did in fact show objective signs of undue physical reaction to the operational environment The distinction between the normal (in the sense of usual) reaction to strain and abnormal reactions which might portend neurotic illness was necessarily a fine one, and the appreciation of lesser degrees of abnormality presupposed a precise knowledge of the limits of normal variability round the average Upon such knowledge rested many of the hopes that medical supervision could make a useful contribution to the prevention by anticipation of psychological disorder in flying crews

A considerable body of experience of the characteristic patterns of *symptoms, behaviour, and* operational performance was obtained in the various Commands of the R A F (Symonds and Williams, 1947) During most of the war, however, little information was available about the objective physical measures of stress either as a group or individual phenomenon Given such physical measures, it should be possible to make a quantitative assessment of the effects of stress in a homogeneous group of flying men, e g night-fighter pilots, and to determine whether, for example, there was a critical point in the prevailing length of tour of duty expected of them beyond which a consistent deterioration set in Again, if the individual variability round the general trend of the physical index used could be measured, the significance of an individual's aberrant reaction could be readily assessed in terms of this index

Some work done on this subject has already been reported (Reid, 1947) Weighing a large group of men engaged in night bomber operations at one point in time demonstrated that, compared with those who had not started their operational tour, men who had done up to 12 bomber sorties showed a drop in weight of about 2 lb After the twelfth sortie, stabilization took place and weight was maintained about that level in those who survived That this drop in weight probably signified that fluctuation in body weight was objective physical evidence of the effects of stress was suggested by contemporary evidence of an increase in the incidence of psychological disorder and minor sickness during the first part of the tour and a fairly stable rate thereafter This meant that in so far as these indicators were valid, there was no point within the general tour limit of 30 bomber sorties beyond which a consistent decline in health and morale appeared

This approach involved the measurement, at one point in time, of different men at different stages in their operational tour It had the practical advantage that it produced a useful answer relatively easily and quickly, since there was no need to follow a series of men over a tour lasting perhaps six to nine months But there was no doubt that the alternative method of performing repeated measurements on the same individuals over a period of time was intrinsically more attractive Despite the very considerable administrative difficulties involved, it had the advantages that it eliminated, by measuring the same man at different stages of his tour, the variation between individuals which might blur a trend in the index over a number of sorties Again, although the first method was necessarily limited by the numbers involved to a crude measure such as bodyweight, the possibility of observing a small group of individuals permitted the use of more elaborate and thus perhaps more sensitive objective measures of physical deterioration

It was decided, therefore, to look for rather more finely balanced physiological functions which might be expected to react sensitively to environmental stresses on the individual, yet which would be susceptible to reliable measurement The importance of vision in flying and the special experience of the medical branch of the R.A F in applying tests of visual function made the choice of such tests appropriate The Consultants in Neuropsychiatry and Ophthalmology, Air Vice Marshals Sir Charles Symonds and P C Livingston, therefore agreed to initiate a field trial of tests of visual function as a physical measure of the effects of operational stress in night bomber crews

Outline of Method

The special tests of visual function selected for study were, with one exception, those used routinely in the selection of men for flying duties in the R.A F The technique of measurement in each case is described in full in the Air Ministry publication "Medical Examination for Fitness for Flying" (1941) Tests of visual acuity were included in the survey, but the main emphasis lay on tests of visual judgment or of ocular balance The function of accommodation in particular was thought to be most liable to upset by general strain All the tests available for the detection of ocular muscle imbalance were used, and a test of physiological diplopia, then being developed by Livingston, was added The final selection thus included

Bishop Harman Diaphragm Test —This is designed to estimate "the desire for binocular vision" This is a dissociation test where an adjustment is made for inter-pupillary distance and the degree of exophoria or esophoria indicated on a scale calibrated from 0 to over 8

Maddox Wing Test —This is likewise a dissociation test of ocular poise where the esophoria or exophoria is recorded in terms of dioptres

Binocular Gauge Test —This is a test of accommodation where the distance from the eye at which convergence on accommodation is seen to break down is measured in centimetres for each eye separately

Experimental Test of Physiological Diplopia —This was designed to estimate the degree to which this function was affected by continued operational strain In this instance, the results were expressed in degrees

All these tests were applied in a rigidly standardized fashion throughout the experiment by the *same orthoptist (Section Officer J Norman* W A A F) Before the field trials began, repeated assessments were made on the same individuals at intervals of some days to gauge the reliability of the measures used These preliminary trials proved satisfactory and the field studies were started at a base from which were operating a squadron of Mosquito aircraft (carrying a pilot and navigator only) and a squadron of Lancaster aircraft carrying the usual crew of seven Both squadrons belonged to the Pathfinder Force of Bomber Command and to that extent were selected from the main body of the heavy night bomber force The operational role of the two squadrons differed slightly, but in general they both shared the environmental conditions prevailing in Bomber Command of the R A F during the intensive efforts of 1944

At the outset of the field study, all available operational crews were examined at rest during the day The results of this examination then formed the base line from which subsequent deviations could be measured At the same time, the individual's operational experience, counted in the number of sorties performed to date, was recorded together with his crew duty and his level of day visual acuity

At intervals during the remainder of their tour these men were examined on their return from an operational sortie Their experience (in sorties) at each examination, and the details of the weather, height, range, and opposition met with during that particular sortie, were noted As fresh replacements arrived for the squadrons, they too were included in the survey

After some months there thus became available a series of measurements on the same individual at

different stages in his operational tour The average value for each of the measures proposed could then be worked out for each stage, 0, 1-5, 6-10 sorties, etc , and the general trend compared with previous results in this field A review of the variation between the duration of individual sorties showed that it was too small to make possible any useful comparison between visual changes after sorties differing in duration or type Attention was therefore mainly given to the behaviour, within a group, of visual function as a response to stress and to the deviation of an individual at different stages throughout the tour both from his own and from the group norm

Summary of Results

From the data available, one reading for each type of measurement for each individual was taken at the nearest point to the later limit of the experience grouping, 1-5, 6-10, 11-15, 16-20, 21-30 sorties At this point, it was assumed, the effect of cumulative stress between, say, the sixth and tenth sortie would have been at a maximum If no significant trends were visible using this material, then it was unlikely that any other method of selection, e g taking the median observation within the experience group, would have produced significant findings

Accommodation —Accommodation fatigue has long been considered a prominent sign of general fatigue Taking this visual function first, then, we can set out the results of the Binocular Gauge Test of accommodation as in Table I The differences between the results given by right and left eyes are negligible (in fact the correlation between them is $r=0\ 9044$, $n=100$, $P<0\ 01$) and the two readings have been combined to give the mean accommodation averaged in each section of the operational tour in Table I

The trend seen in the "total" row is fairly consistently evident in each of the various types of crew duty in both squadrons In the Lancaster squadron, the level at which objective failure in accommodation occurs rises to a peak about the tenth sortie and remains fairly stable at that level during the remainder of the tour This trend, which is suggestive of an initial period of adaptation to stress followed by a period of stabilization is very similar to the trend in weight loss and in the incidence of psychological disorder already noted It seems reasonable to suppose that all three measures indicate the group reaction in a heavy night bomber formation to a tour of duties of 30 operational sorties

On the other hand, although the basic trend of

TABLE I

Mean Accommodation Scores (R and L) at Different Stages of Tour

Squadron	Resting		Stage in Tour									
			1-5		6-10		11-15		16-20		21-30	
	No	Score	No	Score	No	Score	No	Score	No	Score	No	Score
Lancaster												
Pilot	10	8 85	10	9 95	10	11 88	7	10 76	5	10 80	4	10 75
Navigator	12	9 33	12	11 70	12	12 74	7	12 46	5	11 75	2	11 33
Air bomber	11	9 05	11	10 95	11	10 40	9	10 67	6	10 41	4	11 85
Wireless operator	8	9 28	8	10 67	7	11 26	4	10 75	5	10 64	2	9 15
Flight engineer	5	9 20	5	11 52	5	11 50	5	12 35	5	11 92	3	11 40
Air gunner	19	9 21	19	10 38	18	10 22	12	11 16	10	11 07	5	11 74
Total	65	9 13	65	10 78	63	11 20	44	11 30	36	11 06	20	11 21
Standard deviation		2 09		2 02		2 21		2 73		2 78		2 03
Mosquito												
Pilot	18	10 05	10	10 44	13	10 98	14	11 58	12	11 76	10	12 02
Navigator	18	9 11	10	10 99	13	10 80	13	10 50	12	11 49	10	12 97
Total	36	9 58	20	10 72	26	10 89	27	11 06	24	11 63	20	12 49
Standard deviation		2 50		1 79		1 77		2 12		2 08		2 6-

adaptation also appears in the results for the Mosquito squadron, there is a suggestion of a terminal rise which might indicate a physical deterioration resulting from excessive stress associated with the squadron's rather different role For several reasons such questions can hardly be answered by the data in their present form The application of tests of significance for the trends observed is complicated by the fact that, owing to attrition and replacement, the population examined differs from stage to stage Some of the men will be represented at each stage, others only at some stages, so that not only are the mean scores at different stages not independent of each other, but also some of the differences observed may be the result of differences between individuals rather than the true result of changing adaptation to stress Further, it is possible that men with subnormal powers of accommodation may be inefficient, e g in piloting and gunnery, and therefore less likely to survive a tour Such a relationship would tend to lower the average level of accommodation by the selective elimination in action of those with adverse (i e high) scores in the Binocular Gauge Test The possibility of a masking of the results must be considered and the evidence for such a supposition is set out in Table II In this table are given the members surviving beyond their twentieth sortie among groups achieving good or poor scores in a test applied before the beginning of their tour of operational duty Although the differences are suggestive, the combination of the uncorrected χ^2 values for the two tables gives a value of $\chi^2=4\ 053$, with $0\ 20>P>0\ 10$ for $n=2$, so that it is unlikely that selective elimination is a serious source of error in the analysis

It is easy to show that, as in Table III, there is a significant increase in Gauge Test score, i e a lessening in efficiency of accommodation, after the first operational sortie over the resting level measured before the tour starts This means that, even in the short term context before the cumulative stress of the operational tour has begun to take effect, the Gauge Test of accommodation is a useful indicator of reaction to the operational task

TABLE II

INITIAL ACCOMMODATION SCORE AND SURVIVAL IN OPERATIONS

Gauge Score	Total	Survived	Not Survived	Survived (%)
Lancaster Squadron				
Good (7-8 5)	15	10	5	67
Poor (9-)	21	10	11	48
$\chi^2=0\ 6300$ $n=1$ $0\ 50>P>0\ 30$				
Mosquito Squadron				
Good (7-8 5)	29	12	17	41
Poor (9-)	36	8	28	22
$\chi^2=1\ 9409$ $n=1$ $0\ 20>P>0\ 10$				

TABLE III

GAUGE TEST SCORES BEFORE AND AFTER FIRST OPERATIONAL SORTIE

Lancaster Squadron* Crew Duty	No	Mean Score (R & L eyes) Before	After
Pilot	10	8 85	9 85
Navigator	12	9 33	11 29
Air bomber	11	9 05	10 64
Wireless operator	8	9 28	10 47
Flight engineer	5	9 20	10 60
Air gunner	19	9 21	10 50
Total	65	9 16	10 58

* Difference=1 42 t=7 72 for n=64 $P<0\ 01$

Mosquito Squadron† Crew Duty	No	Mean Score (R & L eyes) Before	After
Pilot	18	11 06	10 75
Navigator	18	9 11	10 86
Total	36	9 58	10 80

† Difference=1 22 t=3 41 for n=35 $P<0\ 01$

For the reasons given above however it is less easy to measure the significance of the long-term trends apparent in Table I The difficulties of non-independence can be overcome by taking from the accumulated records the results at or near 0, 5, 15 20 and 25 sorties in individuals who survived the tour and were examined regularly throughout it The use of recordings made on the same individuals at regular intervals during the tour simplifies the application of analysis of variance technique to the study of the stage-to-stage trends The data are set out in full in the appendix (page 109), but

TABLE IV

MEAN ACCOMMODATION AT SUCCESSIVE STAGES IN TOUR

Squadron	No	Stage in Tour 0	5	10	15	20	25
Lancaster	19	8 74	9 92	11 37	10 82	10 95	11 66
Mosquito	6	8 00	11 25	10 17	11 42	11 42	12 00
Total	25	8 56	10 24	11 08	10 96	11 06	11 74
Standard deviation		1 872	2 001	2 853	2 861	2 438	2 611

Table IV gives the means at each stage in each squadron together with the standard deviation of the total observations at each stage

Comparing these results with those in Table I, it is clear that the same general trends arise, yet in this instance a terminal change appears in the last stage of the tour in both squadrons The numbers are rather small, so that it is probably safer to use the whole of the data provided by the repeated measurements on all 25 individuals

Looking first at the variability of the observations at successive stages, there is a hint that the variability increases with progress through the tour to reach a maximum about the fifteenth sortie Application of Bartlett's test for the differences between variances, however, shows that they could well have arisen by chance ($0\ 20 > P > 0\ 10$) On this basis, homogeneity of variance over the series of arrays can be fairly safely assumed and analysis of variance carried out The results of that analysis appear in Table V

From the analysis of Table V it is clear that, since the " between-stage " mean square is significantly greater than the " error " mean square given by the within-stage residual variance, real differences in mean accommodation score exist at different stages of the operational tour These differences follow a trend which, as the splitting up of the " between-stage " sum of squares shows, could be best described by fitting a curved regression line of a cubic type Such a curve was in fact fitted to the data by Fisher's method of using orthogonal polynomials and the closeness of the fit to the means is seen in Fig 1 This method of fitting a curve to describe each significant feature of the data permits fairly confident interpretation Clearly, there is a real, in the sense of technically significant, rise in the mean accommodation score in the Binocular Gauge Test during the period of adaptation to operational stress Between the tenth and the fifteenth sortie, stabilization takes place, but in the last part of the tour, there is clear evidence of a deterioration in the power of accommodation In this last respect the present result differs from the

TABLE V

ANALYSIS OF VARIANCE OF MEAN GAUGE SCORE

Source	Sum of Squares	D F	Mean Square	F
Linear term	118 8206	1	118 8206	49 55*
Quadratic	18 8576	1	18 8576	7 86*
Cubic	15 7236	1	15 7236	6 56†
Between stage residual	0 6515	2	0 3253	<1
Between stages	154 0533	5	30 8107	12 85*
Between individuals	590 9600	24	24 6233	10 27*
Within stage residual	287 7800	120	2 3982	
Total	1,032 7933	149		

* Highly significant $P < 0\ 01$ † Significant $P < 0\ 05$

findings for the other indices of the effects of strain, such as weight loss, used in previous studies on the health of Bomber Command as a whole In part this may be the result of excessive stress on the Pathfinder Force from which the two squadrons were drawn, but it may equally be an indication of the sensitivity of the method now being discussed

There is one last point of importance in this context The 25 individuals whose records have been thus analysed all survived an operational tour Their response to strain therefore represents the reaction of a sample of the whole crew population of particular quality Taking their experience as a model of "normality" in response to the stress of bomber operations, it should be possible to lay down "control limits" outlining the likely range of individual deviations from a standard expectation based on this response curve

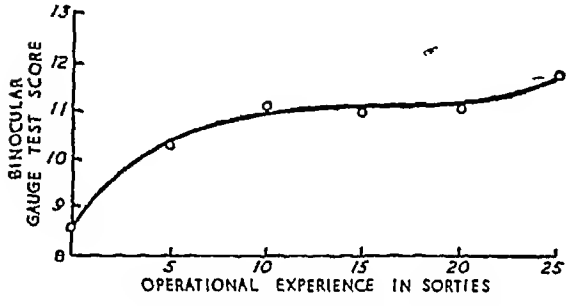

FIG 1 Trend in accommodation test results during operational tour

might be said that only one in twenty individuals of a group measured at the same stage in their tour will have a score differing by more than $2 \times 2\ 5 = 5$ units from the group mean at that stage

These limits can be minimized and thus made more useful by eliminating this variability between individuals This can be done by relating an individual's score at each stage to the resting score of that individual before starting the operational tour, i e the score at any stage is expressed as a deviation from the base line of the resting score The expected "normal" upward trend from this base line is given by the curve fitted to the means starting from the resting score Round this expectation there will be, at all stages, a variation

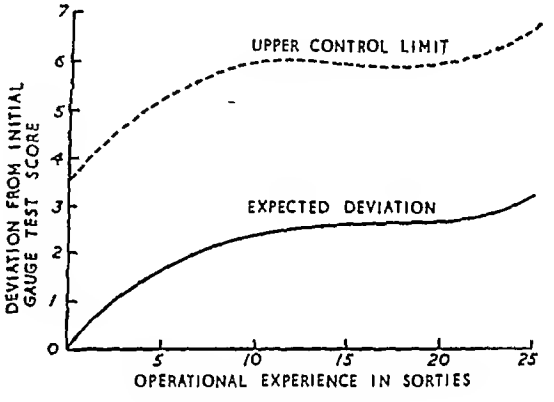

FIG 2 Control limit of accommodation scores during operational tour

The variation between individuals is, of course, considerable At any particular stage in the tour the accommodation scores for a series of individuals will vary about the point on the curve appropriate to that stage in the tour with a variance which can be estimated from Table V The difference between the "between-individual" mean square and the "within-stage" mean square (22 2251) is due to the variance between individual levels which can be estimated by dividing 22 2251 by 6, the number of stages upon which it is based To this result (3 7041) must be added the final residual variance which is a measure of the variability in the scores of any one individual round his own mean score at any one point in the curve tour (2 3982) The resulting variance estimate (6 1023) gives a standard deviation of $\sqrt{6\ 1023} = 2\ 47$ for the variation of the scores for a series of individuals round the mean appropriate to some fixed stage in the tour Assuming normality of distribution and taking the limit to the nearest point of the measuring scale (2 5) it

in score for the same individual of a size indicated by the "within-stage" variability of Table V (2 398) This variance will apply to both initial and subsequent measurements so that the significance of the difference between them must be assessed in terms of the standard error of that difference which is derived from the sum of their variances $\sqrt{2 \times 2\ 398} = 2\ 19$

This value of 2 19 units is a guide to the variability likely to be found round the expected difference between the initial observed resting score and measurements made at subsequent stages of the tour Certainly such an estimate of variability is at best an estimate which is least accurate at the extremes of the operational experience scale, but within this range of experience it does give an adequate indication of the limits of "normal" variability in the differences between resting and subsequent scores Control limits based on this estimate of variability, can thus be laid down so as to include all but any desired proportion of the

scores An upper limit set at 3 6 units above the expected difference for each stage in the tour, for example, as in Fig 2, where 3 6=normal deviate for 95 per cent (1 65)×standard deviation (2 19), will include all but 5 per cent of the scores likely to be observed in a " normal " group of individuals Only if an individual's score at any point in his tour is above the " upper control limit ' appropriate to that stage could it be suggested that his reaction to stress was definitely unusual or significant Whether such an unusual physical reaction is necessarily predictive or indicative of illness cannot, of course, be determined from the present data, but such a deviation from expectation certainly suggests that his resilience under strain is suspect and that particular care must be taken in his medical supervision

Ocular Balance —The results of the tests of ocular balance used (the Maddox Wing and the Bishop Harman Diaphragm tests) were obtained for the same 25 individuals for whom records were available throughout the tour The unusual metric used in these tests makes any sophisticated analysis quite unrealistic It is difficult, for example, to give numerical meaning to a shift from exophoria of two degrees to an esophoria of one degree, and it is probably adequate merely to note the changes in distribution with increasing experience in a group of flying men This is done in Tables VI and VII where, for the same 25 men, are given the distributions of the results of Maddox Wing and Bishop Harman Diaphragm tests applied at different stages of the tour In the first case, the χ^2 test would suggest that the changes in distribution differ insignificantly from stage to stage This test, however, takes no account of trend and there is some indication that there is a decrease in the proportion of esophoric readings after the tenth sorties This change is so slight, however, that it seems unlikely to have much practical value in this context Similarly, however, the scores of the second test were divided up, the resulting distributions were remarkable only in their stability and statistical

TABLE VI

DISTRIBUTION OF MADDOX WING TEST SCORES THROUGHOUT TOUR

	Stage in Tour					
	0	1	5	10	15	25
Considerable esophoria (6+)	15	15	14	10	11	11
Remainder	10	10	11	15	14	14

χ^2=4 1904, n=5, 0 70>P>0 50

TABLE VII

DISTRIBUTION OF BISHOP HARMAN DIAPHRAGM TEST SCORES THROUGHOUT TOUR

	Stage in Tour					
	0	1	5	10	15	25
Esophoria (1–)	5	6	5	4	5	2
Remainder	20	19	20	21	20	23

tests are superfluous It would appear, then, that neither of these two tests gives the same promise as a measure of the response to stress as does the gauge test of accommodation

Physiological Diplopia —The average values found by using the test of physiological diplopia at each stage in the tour are given in Table VIII where the observations are expressed in terms of the deviation from the resting value It is clear that, although there are differences in a negative direction between the resting value and the score made on test on

TABLE VIII

MEAN DEVIATION FROM RESTING RESULT IN DIPLOPIA TEST THROUGHOUT TOUR

Squadron	Stage in Tour											
	1–5		6–10		11–15		16–20		21–25		26–30	
	No	Mean	No	Mean	No	Mean	No	Mean	No	Mean	No	Mean
Lancaster	56	+0 1607	64	−0 8438	44	−0 5455	36	−2 7222*	20	0 0500	15	3 4000*
Mosquito	20	−0 2500	26	−0 5385	26	−0 2692	24	−0 7083	20	1 0000	12	1 0000

* test gives a probability of <0 01 in these instances

return from a sortie, these differences reach significant levels on only two occasions Further, there is no consistent trend between the mean values at different stages of the tour at all comparable with the trend seen in accommodation and the other physical indicators of the effect of stress For these reasons, it seems fairly certain that this test, at least in its present form, is not of value in the detection of either short-term or cumulative fatigue

Discussion

A review of these results suggests that in tests of accommodation we have a sensitive, accurate indicator of the reaction of individuals to a harassing environment The use of a sensitive test in repeated examination of the same individual during a period of strain gives the same indications as do cruder measures, such as loss in bodyweight, when assessed in different individuals at different stages in their tour It is also clear that the tests of ocular poise and of physiological diplopia give no such promise

In the supervision of the health of flying men, the indications of terminal deterioration appearing in this study may be useful in determining the optimum limits of the operational tour As has been shown, however, individual differences are considerable but, if each individual's performance on test can be related to his own resting level before the period of stress began, the general experience of the group to which he belongs can be used as a guide to the reaction likely to be observed The deviation of an individual's score from that expectation must be assessed in terms of the usual variability likely to be found between repeated observations, and this variability can be readily estimated

The possibility of using similar techniques in the study of short and long-term fatigue in industry should be considered Admittedly the physical changes noted in this survey have been the result of a stress of particular intensity But they have arisen in men of exceptional calibre The less dramatic strains in industry operate on a much less highly selected population, and with large numbers and more sensitive tests useful indications of group reaction to environment may be obtained

Summary and Conclusions

A statistical analysis has been made of the results of a survey of the effects of operational flying stress on the visual function of men of two bomber squadrons of the R.A.F during the later stages of World War II It is suggested that tests of accommodation were sensitive indicators of the reactions of men to the exceptional stress of their environment at that time

Such tests, repeated on the same individuals at intervals throughout the tour, gave substantially the same indications as did the trend of weight differences between a large series of different men measured at different stages in the tour In both instances there was evidence of a period of adaptation to stress when mean weight fell and the power of accommodation deteriorated, but then, after about the tenth sortie in a tour limited to 30 sorties stabilization at a new level took place Confirmation of this interpretation comes from similar trends in the incidence of psychological disorder at different stages in the tour

The use of a test of accommodative power had additional advantages it seems to be able to discriminate in a fairly objective fashion between *resting performance and performance in the fatigue* state on completion of a sortie More important however, is the suggestion that by the repeated use of sensitive tests on the same individuals, it might be possible to detect long-term trends in cumulative fatigue The value of such indications in laying down optimum limits of duration of operational employment is discussed and suggestions are made for the use of the estimates of variation in an individual's performance from time to time to estimate the significance of his deviation from the average performance of a group subject to the same cumulative strain

The more precise methods of supervision of health suggested in this study may have a wider application in occupational medicine

Similar study of tests of ocular poise and physiological diplopia gave no clear promise of usefulness in this field

I am indebted to Sir Charles Symonds and Professor A Bradford Hill, Consultants to the Royal Air Force in Neuropsychiatry and Medical Statistics, for their advice and to the Director-General of Medical Services of the Royal Air Force, Air Vice Marshal P C Livingston, both for his help while Consultant in Ophthalmology and for permission to publish this report. To Mrs K M Bull Miss B M Miller, and Miss O M Penfold I am obliged for their clerical and computing assistance and to Mrs M G Young for drawing the diagrams

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APPENDIX

BINOCULAR GAUGE TEST SCORE AT DIFFERENT STAGES IN TOUR

SQUADRON	Stage in Tour in Sorties					
	0	5	10	15	20	25
LANCASTER						
Pilot	9	12	11	10	10 5	12 5
	8	9	7	9	13	11
	7	10	13	11	12	12
	7	8	8 5	11	8	9
Navigator	9	11	13	11	11	12
	7	8	11	8 5	9	10
Air bomber	10 5	14 5	12	12	10	13
	9	9 5	13	10	12	12
	8	9	10 5	10 5	12	12
Wireless operator	7	10	9 5	7	8	9
	8	9 5	10	—*	10	10
Flight engineer	12	12	16	17	13	17
	8	9	8	11	10	10
	7	11	11	8 5	10	9
Air gunner	12	9 5	19 5	19 5	19 5	19
	8	8	11	8	10	11
	7	8	8 5	9 5	9	9
	15 5	12 5	15 5	13	11	14
	7	8	8	8 —	10	10
MOSQUITO						
Pilot	9 5	10	11	11 5	11	11
	8	10	9	9	10	10
	7	10 5	10	11	10	13
Navigator	9 5	12 5	8	9	9	9
	7	15 5	12	14	14 5	16
	7	9	11	14	14	13

* Value estimated by missing plot technique was used in analysis

THE CARE OF THE CHRONIC SICK

I MEDICAL AND NURSING REQUIREMENTS*

BY

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INTRODUCTION

If we are not now aware that old age and chronic sickness are among the most urgent of contemporary medical problems, it is not the fault of the numerous writers who have tried to persuade us Their case is supported by national statistics, and stated briefly amounts to this the fact that preventive medicine (to use the term in its most inclusive sense) has reduced the incidence of disease in younger age groups means that a higher proportion of the general population suffers from the diseases of old age, the relative contribution of these diseases to the total incidence of disease is already high and is increasing, we are comparatively ignorant about the diseases of late life and have the best of reasons for learning more about them (in this matter we have the double interest of the actuary and of the insured)

In this paper, the first of a series based on an investigation of the chronic sick in hospital, we deal mainly with administrative difficulties created by these diseases It will be useful first to consider the reasons which have led to the coupling of the problem of chronic sickness with that of old age, for if we use the term chronic sickness in reference to diseases which continue or recur over a considerable period, it is quite evident that it is not limited to late life Bronchitis, rheumatic heart disease, and disseminated sclerosis are examples, in the respiratory, circulatory, and nervous systems respectively, of chronic diseases which commonly appear for the first time in young people The fact that we associate chronic sickness with old age reflects a natural preoccupation with the administrative problem As scientists we should like to know the proportion of the chronic diseases which first appear in each age group, but as medical administrators we are more concerned with the proportion of individuals in each age group who require attention

It is known that most patients who need continuous care are old, but there is no detailed information about the kind of care they require The only substantial numerical data are based on returns of hospitals for the chronic sick, and give the total population in hospital, these figures have also been subdivided into "chronic sick" and "aged and infirm"†, but the division tells us nothing of the medical and nursing requirements of patients in each group We have only to recall the way in which cases were admitted until July, 1948, to recognize the mixed nature of this hospital population The medical needs of the elderly patient cannot be considered apart from the social circumstances in which they arise, and the general practitioner who stated to the relieving officer that in his opinion a patient should be admitted to hospital was inevitably influenced by the inadequacy of facilities in the home, as well as by the urgency of the need for hospital treatment Even more important, as we shall show in a later paper, it has frequently been necessary to retain in hospital patients whose need for frequent medical attention or skilled nursing was transient, but whose home circumstances prevented discharge

This was a situation which the Poor Law authorities could accept with composure They were responsible for the social as well as for the medical needs of many of their patients, and the vicarious burden on their hospitals was compensated by relief for other parts of their administration Indeed having regard to the limited staff and equipment used in the hospitals it was even possible that an elderly patient not requiring medical attention or skilled nursing could be provided for as economically in a hospital bed as elsewhere

There was no important change during the period of administration under local authorities (1929-1948),

* This research was assisted by a grant from the Birmingham University Students Social Services Fund

† Report of the Working Party on the Recruitment and Training of Nurses, p 107

and the hospitals transferred in July, 1948, to regional hospital boards still housed deprived children, the aged and infirm, and the destitute of all ages, as well as the chronic sick But the responsibility of the new authorities was limited sharply by act of parliament to hospital care, and, faced with the unpleasant facts of long waiting lists and too few beds, they naturally viewed with concern the possibility that their hospitals contained patients who could be cared for more economically elsewhere, and who were in any case not their problem

The reasons for concern about this situation are not all administrative ones We know that the social and medical attention which patients later require are determined to some extent by the adequacy of the services to which they have access in the acute stages of their illness Continence and mobility in particular reflect the standard of care received The fact that hospital beds are scarce, and likely to remain so for some time to come, makes it important that they should not be occupied by patients who no longer need hospital attention

We have attempted in this paper to answer two questions (1) What proportion of the chronic sick require the kind of medical or nursing attention provided in hospitals? (2) What facilities are needed for patients who can more satisfactorily or more economically be cared for outside hospitals?

For this purpose it has been necessary first to define the nursing and medical attention which justify hospital care, and second to examine the requirements of patients in relation to these standards

Material and Methods

The numerical data in this paper are derived from an analysis of 1,005 patients in Western Road Infirmary, Birmingham A brief account follows of the nature of this material and of the extent to which it may be regarded as representative of the problem of chronic sickness in the country as a whole

Western Road Infirmary is typical of many institutions provided as workhouses under the Poor Law Amendment Act of 1834 and administered by a Board of Guardians elected locally to serve the surrounding parishes To the original workhouse, now more than a hundred years old, was added during the nineteenth and twentieth centuries a series of hospital blocks for the sick and infirm destitute These are badly planned buildings, with high windows narrow ward doors and totally inadequate kitchens and sanitary arrangements, designed with an eye on the cost to local rates rather than on the convenience of patients and staff Under the Local Government Act of 1929 this building came under the control of the Public Assistance Committee of the Birmingham City Council, and on July 5, 1948, the hospital wards were transferred to the Regional Hospital Board The old workhouse, consisting of 299 beds for the poor and destitute, has been taken over by the local authority's social welfare committee complying with the National Assistance Act of 1948

The occupants of these 299 beds, and of 155 beds used for venereal and skin diseases, are excluded from the survey, which covers only the 1,005 patients classified by the Chief Medical Officer as "chronic sick" The beds used for these various purposes are to some extent interchangeable, and the numbers vary slightly from time to time

After a preliminary survey of 50 patients, a record card was designed for hand sorting It was divided into two parts a medical section, completed by one of three doctors, and a social section, completed by one of two social workers Records were inspected on completion, and returned for attention to inconsistencies or omissions The staff engaged on this work were married women with some domestic responsibilities, who gave part-time service under the supervision of one of us (C R L) This arrangement, necessary because of the difficulty of recruiting doctors and social workers for full-time service for a limited period, was entirely satisfactory in an enquiry in which the exacting nature of the work made full-time employment undesirable

The data are mainly the results of physical examinations and of histories taken from the patients Where the latter sources were not available (20 per cent of patients were grossly abnormal mentally, and 4 per cent were deaf) or were considered unreliable, relatives were interviewed on visiting days No home visits were made, and where data in respect of domestic circumstances could not be obtained from patients or relatives the items were entered as "unknown" Much of the medical data was provided or confirmed by the ward doctor or sister, and records of mental state mobility, and bladder and bowel habits, were completed only after consultation with them The hospital records, though adequate for the needs of the hospital staff, were of little use for research purposes The medical diagnosis and details of laboratory investigations were extracted but no other use was made of this source

We have no reason to believe that the population of Western Road Infirmary differs in any important respect from that of other hospitals of the same type at a later date we can make a comparison with the hospitals in the Stoke-on Trent area where

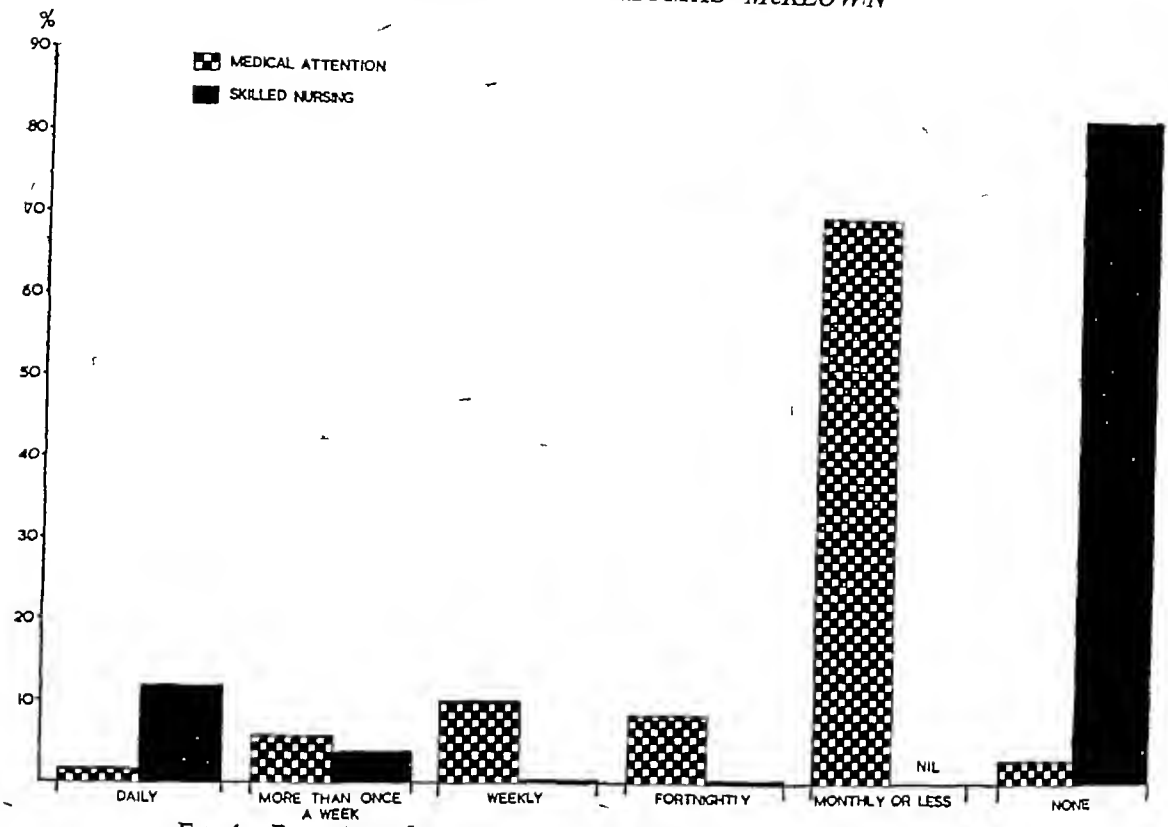

FIG 1 —Proportion of patients requiring medical attention or skilled nursing (see Tables I and II)

the same material has been collected It will be evident that we have no information about patients with chronic diseases cared for in mental, general, or other hospitals, or in their own homes, who are also excluded from the recent national returns, one of which* gives 70,000 as the number of chronic sick in England and Wales Of this total, the 1,005 patients in the survey represent about 1 4 per cent

MEDICAL AND NURSING REQUIREMENTS

Our examination of the medical and nursing requirements of each patient is based upon a distinction between four different types of service (i) medical attention, (ii) skilled nursing, (iii) simple nursing, and (iv) domestic service

(i) *Medical Attention* —In assessing medical attention needed by patients, we have had regard both to the attention actually received in hospital and to that which the patient's condition appeared to merit In Western Road Infirmary, in conformity with usual hospital practice, every ward is visited daily, and medical supervision given if required Needless to say, this frequent attention is in many cases quite unnecessary, and for our records the appropriate interval has been decided in each case after careful consideration of the patient's condition

The results of this examination are contained in Table I (see also Fig 1), which may be summarized in the statement that although nearly all patients (97 per cent) require medical attention, few of them (7 per cent) need it more frequently than once a week, and only about a quarter more frequently than once a month

(ii) *Skilled Nursing* —The distinction which we have considered it imperative to make between skilled and simple nursing is not a usual one The duties of the State Registered Nurse are not as a rule limited to those in which training and skill are required, nor is the work of the assistant nurse restricted to what is described below as simple nursing But it is only by making this arbitrary division that we can assess even roughly the nursing requirements of each patient, and we therefore include under skilled nursing only those duties, such as injections, dressings, administration of dangerous drugs, care of acutely ill people, etc , for which it may

* Report of the Ministry of Health for the year ended March 31 1947

TABLE I*

MEDICAL ATTENTION REQUIRED (see Fig 1)

	Daily	More than once a week	Weekly	Fortnightly	Monthly or Less	None	Totals
Males	10 (2 2)	36 (7 9)	61 (13 4)	44 (9 7)	282 (62 0)	22 (4 8)	455 (100)
Females	6 (1 1)	22 (4 0)	42 (7 6)	41 (7 4)	431 (78 4)	8 (1 5)	550 (100)
All patients	16 (1 6)	58 (5 8)	103 (10 2)	85 (8 5)	713 (70 9)	30 (3 0)	1 005 (100)

* In all tables percentages are given in brackets

TABLE II

SKILLED NURSING REQUIRED (see Fig 1)

	Daily	More than once a week	Weekly	Fortnightly	None	Totals
Males	65 (14 3)	24 (5 3)	2 (0 4)	1 (0 2)	363 (79 8)	455 (100)
Females	55 (10 0)	14 (2 5)	1 (0 2)	2 (0 4)	478 (86 9)	550 (100)
All patients	120 (11 9)	38 (3 8)	3 (0 3)	3 (0 3)	841 (83 7)	1 005 (100)

TABLE III

SIMPLE NURSING REQUIRED

	Required	Not Required	Totals
Males	414 (91 0)	41 (9 0)	455 (100)
Females	521 (94 7)	29 (5 3)	550 (100)
All patients	935 (93 1)	70 (6 9)	1,005 (100)

reasonably be claimed that full training is necessary

Table II (see also Fig 1) indicates that few patients (16 per cent) require skilled nursing but that those who do require it often Twelve per cent need daily the type of service referred to

(iii) *Simple Nursing*—With the problem of disposal in view, we have also thought it desirable to distinguish clearly between simple nursing and domestic service Many patients need to be washed, fed dressed or lifted into and out of bed, tasks characterized by the personal nature of the service but not requiring skill of the kind referred to under (ii) We have been in doubt about the classification of patients who are incontinent of faeces or urine, but whose care would not otherwise necessitate the presence of a skilled nurse These cases are considered to require simple nursing only, but since it may be argued that the prevention of bed sores is a service for which training and skill are needed, incontinent patients are shown separately in tables where a different decision might have a bearing on disposal Table III shows that 93 per cent of patients require simple nursing

(iv) *Domestic Service*—All patients in Western Road Infirmary need some form of domestic service (shopping, preparation of food, laundry, cleaning, etc) This fact, which requires no further numerical examination, emerged from detailed consideration of individual needs, and has an important bearing on any plans for subsequent disposal

DISPOSAL

The possible disposal of patients is now considered in relation to their medical and nursing requirements It may be necessary to emphasize at once that it is not suggested that the arrangements proposed are available to hospital authorities at this time, beds in general and mental hospitals, for example, are already insufficient for their recognized commitments All that is attempted is to guide future policy by indicating alternative facilities which the requirements of the present hospital population appear to warrant, we have naturally had in mind the importance of freeing hospital beds of all patients for whom satisfactory and more economical arrangements can be made elsewhere

Table IV (overleaf, see also Fig 2) gives the numbers of patients in each of the four main divisions identified as follows

PATIENTS WITHOUT GROSS MENTAL CHANGE

(a) *Hospital* (one-fifth) Patients needing skilled nursing and/or medical attention once a week or more frequently are considered to require hospital care Most patients in this group do, of course need both skilled nursing and frequent medical attention, but cases needing one and not the other are also included It may be objected that where no skilled nursing is required medical attention at weekly intervals should not be provided in hospital but we have preferred to risk criticism of a conservative estimate

(b) *Institution or own home with simple nursing* (slightly over half) Patients who do not require skilled nursing or medical attention as often as once a week are not considered to require hospital care if the necessary arrangements can be made in alternative institutions or in their own homes

(c) *Institution or own home without simple nursing* (slightly under one tenth) Patients in this group are distinguished from the previous one by the fact that they do not require the kind of personal service described as simple nursing.

TABLE IV

SUGGESTED DISPOSAL OF PATIENTS (see Fig 2)

	Patients without Gross Mental Change			Patients with Gross Mental Change	Totals
		Institution or own home			
	Hospital* (a)	With simple nursing† (b)	Without simple nursing‡ (c)	Hospital§ (d)	
Continent	137	390	69	52	648
Incontinent (urine and/or faeces)	52	159	1	145	357
Totals	189 (18 8)	549 (54 6)	70 (7 0)	197 (19 6)	1 005 (100)

* Includes patients requiring skilled nursing, and/or medical attention once a week or more frequently

† *Simple nursing* washing dressing feeding, lifting in and out of bed etc

‡ These patients all require some form of domestic service.

§ Includes all patients requiring supervision because of their abnormal mental state

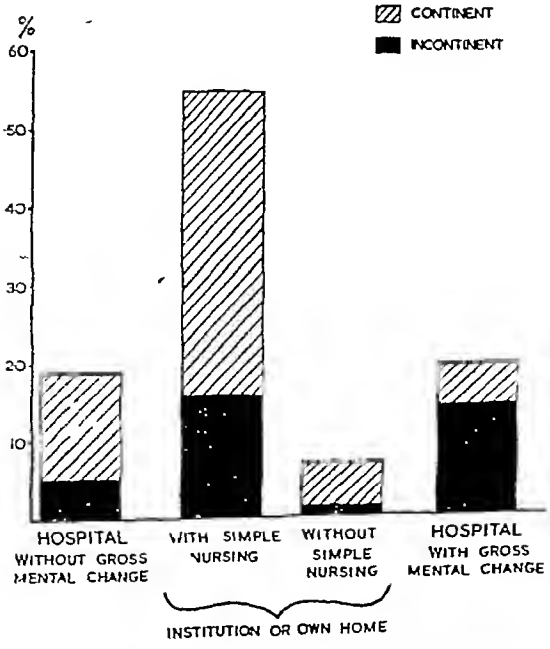

FIG 2 —Suggested disposal of patients (see Table IV)

PATIENTS WITH GROSS MENTAL CHANGE

(*d*) *Hospital* (one-fifth) It has been thought necessary to consider separately the disposal of patients whose mental state is such that, irrespective of other medical and nursing requirements, they need personal supervision and must therefore, with few exceptions, be cared for in hospital The group excludes some other patients (distributed between (*a*), (*b*) and (*c*)) who have mental changes of a kind not necessitating personal supervision, such as dullness, apathy, speech difficulty, or failing memory

We next examine in detail the diagnosis, age, duration of stay in hospital, and mobility and continence of the patients in each of these four main divisions, considerations which have an important bearing on the acceptability of the classification suggested above

(*a*) *Patients without Gross Mental Change, requiring Skilled Nursing and/or Frequent Medical Attention* —Tables V and VI (opposite) give for males and females respectively the diagnosis and attention required by the patients in this group Many of them are in the acute and some in the terminal stages of illness, almost all require the kind of attention (dressings, injections, investigations, care of acute illness) best provided in general hospitals

It is mainly in respect of age and duration of stay that these patients differ from those ordinarily admitted to general hospitals (Tables VII and VIII overleaf, see also Figs 3A and 4A), 88 per cent are over 60, half have been in hospital for at least three months, and about one-fifth for at least three years It does not follow, of course, that those who have spent months or years in hospital have been continuously in need of hospital care, on the contrary, most of the long-stay patients have only recently developed the conditions necessitating their inclusion in this group If the necessary alternative facilities had been available, they need only recently have been transferred to an acute hospital, thus reducing the mean duration of stay

Table IX (p 118, see also Fig. 5A) gives details of mobility and continence, about a quarter are incontinent, and two-thirds are confined to bed Objections may be raised to the admission of incontinent patients to acute hospitals, but in many of these cases the incontinence is a temporary phenomenon associated with the acute illness and responsive to adequate treatment Under present conditions in hospitals for the chronic sick, this transient incontinence frequently remains as a permanent disability when the acute illness has subsided

With these data before us, we may examine more realistically than has hitherto been possible the

TABLE V

DIAGNOSIS AND ATTENTION REQUIRED BY PATIENTS WITHOUT GROSS MENTAL CHANGE CONSIDERED SUITABLE FOR HOSPITALS (106 MALES)*

Attention Required	No of Cases	Comments
1 *Acute Illness* (41)		
Cardiac failure	18	
Recent hemiplegia	6	
Acute bronchitis	14	
Other	3	Tonsillitis, herpes zoster, conjunctivitis
2 *Dressings* (33)		
Gangene of foot	7	
Leg sepsis and ulceration	9	Ulcer (4), sepsis (5)
Pressure sore	3	Advanced disseminated sclerosis, paraplegia (2)
Carbuncle	2	
Other skin conditions	2	Exfoliative dermatitis severe eczema
Suprapubic cystotomy	6	With cystitis and requiring irrigation
Recent fracture	4	Femur (2), tibia and fibula, clavicle
3 *Injections* (14)		
Advanced carcinoma	12	
Other	2	Pernicious anaemia, syphilis
4 *Investigation* (18)	18	Includes unexplained jaundice, diarrhoea, vomiting, anaemia vertigo, oedema of legs, haematuria, etc

* Includes patients requiring skilled nursing, and/or medical attention once a week or more frequently

TABLE VI

DIAGNOSIS AND ATTENTION REQUIRED BY PATIENTS WITHOUT GROSS MENTAL CHANGE CONSIDERED SUITABLE FOR HOSPITALS (83 FEMALES)*

Attention Required	No of Cases	Comments
1 *Acute Illness* (31)		
Cardiac failure	12	
Recent hemiplegia	3	
Acute bronchitis	8	
Acute eye conditions	4	Conjunctivitis (3), glaucoma
Other	4	Otitis media (2), subphrenic abscess thyrotoxicosis
2 *Dressings* (18)		
Gangrene of foot	2	
Leg sepsis and ulceration	9	Ulcer (6) sepsis (3)
Pressure sore	1	Advanced paralysis agitans (bedfast 4 years before admission)
Carbuncle	1	Diabetes
Other skin conditions	5	Psoriasis (2), exfoliative dermatitis eczema pemphigus
3 *Injections* (22)		
Advanced carcinoma	13	
Syphilis	3	All cases of long standing
Pernicious anaemia	3	
Diabetes	3	
4 *Investigation* (12)	12	Includes haematemesis, jaundice urinary infection haemoptysis melena epileptiform convulsions ? hyperthyroidism etc

* Includes patients requiring skilled nursing and/or medical attention once a week or more frequently

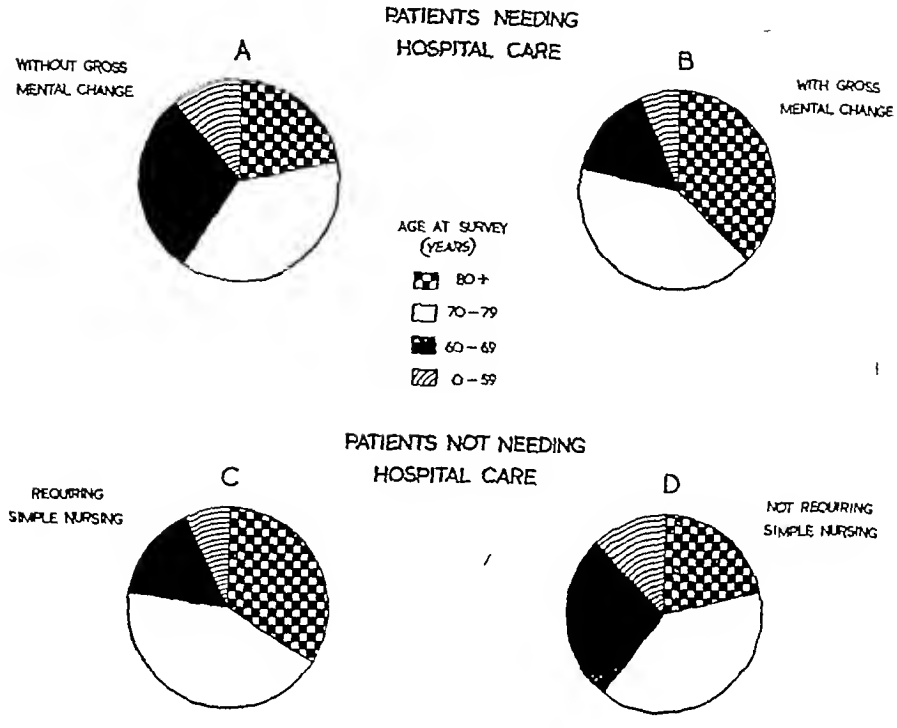

FIG 3 —Age distribution
(see Tables VII, X, XVII, XXI)

suggestion that the chronic sick should in future be cared for in the wards of general hospitals This view has been supported by the following considerations

1 It is very difficult to attract nursing and medical staff to hospitals which cater exclusively for this class of patient.
2 All nurses and doctors should have some experience of the care of the elderly chronic sick
3 Many patients require the type of investigation and treatment which can only be provided with certainty in a general hospital

One further consideration may be added Unless we accept as inevitable the state of apathy and resignation which has characterized these institutions in the past, and which has more in common with the nineteenth century workhouse than with the twentieth century hospital, it is important that the chronic sick should no longer be isolated from the acute sick Many of them are in fact acutely ill, and merit the attention of the general hospital

To this proposal there has appeared to be only

TABLE VII

AGE OF PATIENTS WITHOUT GROSS MENTAL CHANGE CONSIDERED SUITABLE FOR HOSPITALS (see Fig 3A)

Sex	Age at Survey (Years)				Totals
	0-59	60-69	70-79	80 and over	
Males	15 (14 2)	28 (26 4)	40 (37 7)	23 (21 7)	106 (100)
Females	7 (8 4)	27 (32 5)	31 (37 4)	18 (21 7)	83 (100)
All patients	22 (11 6)	55 (29 1)	71 (37 6)	41 (21 7)	189 (100)

TABLE VIII

DURATION OF STAY OF PATIENTS WITHOUT GROSS MENTAL CHANGE CONSIDERED SUITABLE FOR HOSPITALS (see Fig. 4A)

Sex	Duration of Stay (Months)				Totals
	0-2	3-11	12 35	36 and over	
Males	64 (60 4)	17 (16 0)	10 (9 4)	15 (14 2)	106 (100)
Females	32 (38 5)	15 (18 1)	17 (20 5)	19 (22 9)	83 (100)
All patients	96 (50 8)	32 (16 9)	27 (14 3)	34 (18 0)	189 (100)

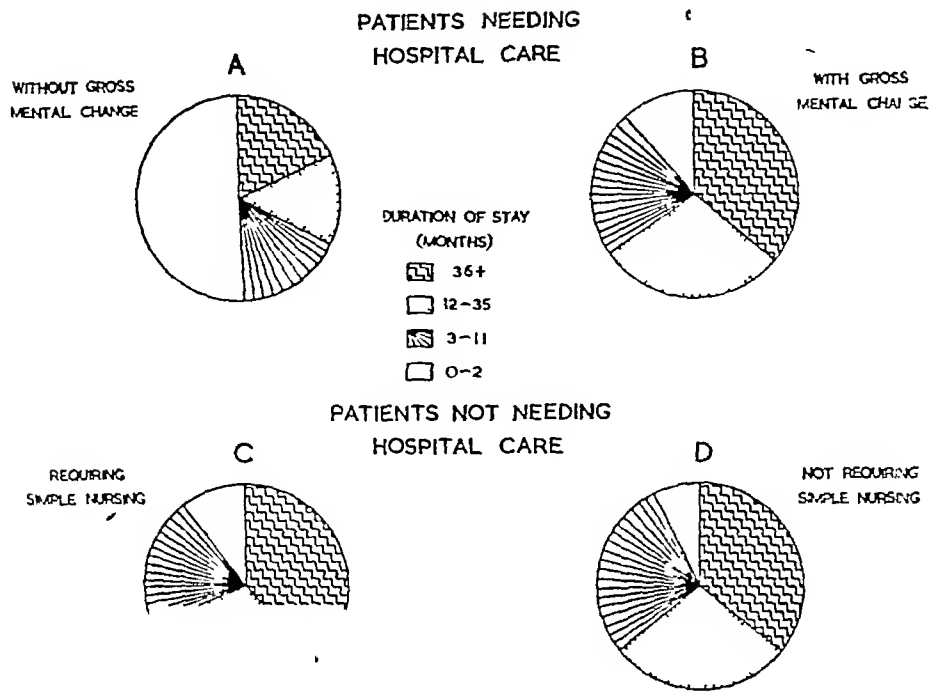

FIG 4 —Duration of stay in hospital
(see Tables VIII, XI, XVIII, XXII)

one objection, but it is a serious one If hospital beds needed for the chronic sick are 2 0 to 2 5 per 1,000 of the population, as suggested by national figures available from the hospital surveys conducted by the Ministry of Health,* roughly one-third of the accommodation of general hospitals† would be needed to provide them But if, as our data suggest, only about one-fifth of the patients are suitable for this type of hospital, the necessary proportion of beds is about one-tenth‡, and what has previously been an attractive also becomes a practical possibility

Without more knowledge of the situation in other parts of the country, as well as of the extent to which this commitment can be further reduced by adequate medical and social services, the figure given cannot have the authority of a final estimate It is likely to be very much nearer to it than any so far available and gives good reason for believing that it should eventually be possible for general hospitals to accept this additional responsibility without serious embarrassment to their traditional work

(*b*) *Patients without Gross Mental Change, requiring only Simple Nursing and Infrequent Medical Attention* —As has been stated, slightly over half the patients are of this type, and in Table IV (and Fig 2) they are classified as suitable for their own homes or for institutions other than hospitals Whether this classification is reasonable cannot be decided without reference to the information about diagnosis given in Tables XIII and XIV for males and females respectively The tables include one indefinite entity (senility), but indicate that most patients are suffering from well-recognized diseases quite properly referred to as chronic diseases, some of which are characterized by long periods in which neither skilled nursing nor frequent medical attention is necessary Three of the largest groups (chronic bronchitis, hemiplegia-recovered arthritis) are conspicuous examples Most of the patients are old (93 per cent over 60 cf Table X and Fig 3C) and have been in hospital for a considerable period (90 per cent for at least three months 70 per cent for at least a year cf Table XI and Fig 4C)

* Ministry of Health Hospital Surveys (H M S O., 1945 1946)

† 2 5 beds for the chronic sick in relation to 5 0 beds per 1 000 of population for the acute sick

‡ 0 5 beds for the chronic sick in relation to 5 0 beds per 1 000 of population for the acute sick

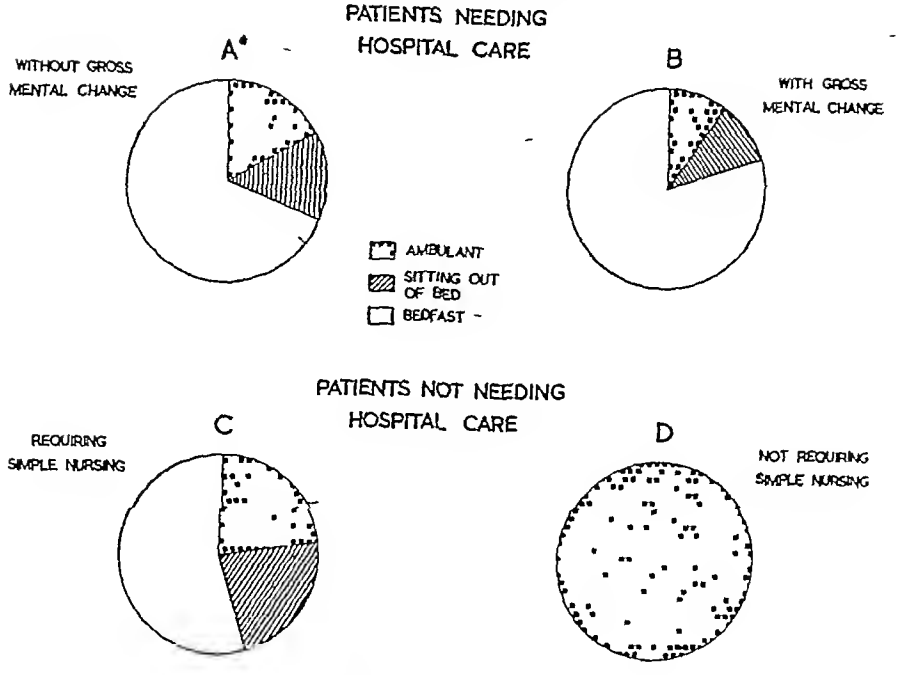

FIG 5.—Degree of mobility
(see Tables IX, XII, XIX, XXV)

Tables XIII and XIV also show that about one-fifth of the men and one-quarter of the women have some kind of mental abnormality, of a degree which would not necessitate reconsideration of disposal (patients requiring supervision because of their mental state are excluded and discussed below under a separate heading) About one-third of the men, and less than one-fifth of the women are ambulant, and about one-third of the women and less than one-fifth of the men are incontinent (Table XII and Fig 5C) It may be felt that patients who are incontinent require skilled nursing, but where there is no other reason we have considered this insufficient grounds for admitting them to hospital

It is evident that nearly all these patients may at

TABLE IX

MOBILITY AND CONTINENCE OF PATIENTS WITHOUT GROSS MENTAL CHANGE CONSIDERED SUITABLE FOR HOSPITALS
(see Fig 5A)

Sex	Males				Females			
Mobility	Bed-fast	Sitting out of bed	Ambulant	Totals	Bed fast	Sitting out of bed	Ambulant	Totals
No Continent	54	10	12	76 (71 7)	36	11	14	61 (73 5)
No Incontinent (urine and/or faeces)	23	3	4	30 (28 3)	17	3	2	22 (26 5)
Totals	77 (72 6)	13 (12 3)	16 (15 1)	106 (100)	53 (63 8)	14 (16 9)	16 (19 3)	83 (100)

TABLE X

AGE OF PATIENTS NEEDING SIMPLE NURSING AND CONSIDERED SUITABLE FOR THEIR OWN HOMES OR FOR INSTITUTIONS OTHER THAN HOSPITALS (see Fig 3C)

Sex	Age at Survey (Years)				Totals
	0-59	60-69	70-79	80 and over	
Males	21 (9 6)	43 (19 5)	102 (46 4)	54 (24 5)	220 (100)
Females	19 (5 8)	42 (12 8)	136 (41 3)	132 (40 1)	329 (100)
All patients	40 (7 3)	85 (15 5)	238 (43 3)	186 (33 9)	549 (100)

TABLE XI

DURATION OF STAY OF PATIENTS NEEDING SIMPLE NURSING AND CONSIDERED SUITABLE FOR THEIR OWN HOMES OR FOR INSTITUTIONS OTHER THAN HOSPITALS (see Fig 4C)

Sex	Duration of Stay (Months)				Totals
	0-2	3-11	12 35	36 and over	
Males	32 (14 6)	54 (24 5)	54 (24 5)	80 (36 4)	220 (100)
Females	25 (7 6)	58 (17 6)	118 (35 9)	128 (38 9)	329 (100)
All patients	57 (10 4)	112 (20 4)	172 (31 3)	208 (37 9)	549 (100)

any time require the service of a nurse or doctor But if this possibility is considered a sufficient reason for their retention in hospital during periods of remission, there is little prospect of relieving the pressure on hospital beds It should not be beyond the bounds of administrative possibilities to admit these patients to hospital during the acute or terminal phase of illness, and to arrange alternative accommodation at other times

(*c*) *Patients without Gross Mental Change Requiring only Domestic Services and Infrequent Medical Attention* —In respect of diagnosis (Tables XV and XVI), age (Table XVII and Fig 3D), and duration of stay (Table XVIII and Fig 4D), these patients are very much like those in the previous group, they differ mainly in that all are ambulant and all but one are continent (Table XIX and Fig 5D), and in consequence they do not need the sort of personal attention described as simple nursing Indeed comparisons of the diagnoses in Tables XV and XVI with those in Tables XIII and XIV indicate that the division here made with an eye to the administrative problem mainly separates different stages in the course of the same illnesses

The administrative significance of the distinction between groups (*b*) and (*c*) rests on the assumption that patients who do not need simple nursing require only domestic services and can dispense with any kind of personal supervision Closer examination of Tables XV and XVI indicates that this is not the case, Though all are ambulant, the majority of these patients are not able to go out of doors, and many cannot climb stairs Indeed, after careful consideration only a few of them were judged suitable for discharge to the ordinary type of municipal home, and some had recently been admitted from such homes because facilities were inadequate for their care The same considerations inevitably determine in many cases whether patients can be accepted in their own homes

Together groups (*b*) and (*c*) make up three-fifths of the present hospital population Whether in future most of them can be cared for in their own homes or in institutions cannot be decided on the

TABLE XII

MOBILITY AND CONTINENCE OF PATIENTS NEEDING SIMPLE NURSING AND CONSIDERED SUITABLE FOR THEIR OWN HOMES OR FOR INSTITUTIONS OTHER THAN HOSPITALS (see Fig 5C)

Sex	Males				Females			
Mobility	Bed-fast	Sitting out of Bed	Ambulant	Totals	Bed-fast	Sitting out of Bed	Ambulant	Totals
No Continent	64	49	69	182 (82 7)	114	46	48	208 (63 2)
No Incontinent (urine and/or faeces)	29	7	2	38 (17 3)	93	22	6	121 (36 8)
Totals	93 (42 3)	56 (25 4)	71 (32 3)	220 (100)	207 (62 9)	68 (20 7)	54 (16 4)	329 (100)

TABLE XIII

DIAGNOSIS OF PATIENTS NEEDING SIMPLE NURSING ONLY, AND CONSIDERED SUITABLE FOR THEIR OWN HOMES OR INSTITUTIONS OTHER THAN HOSPITALS (220 MALES)

	Diagnosis	Continent			Incontinent		
		No of Cases	Mental State		No of Cases	Mental State	
			Normal	Abnormal§		Normal	Abnormal§
1	*Hemiplegia*	31	28	3	14	7	7
2	*"Senility"**	37	33	4	8	5	3
3	*Arthritis*	16	14	2	4	3	1
4	*Chronic Bronchitis*	27	22	5	4	2	2
5	*Cardiac Failure*	16	14	2	—	—	—
6	*Old Fractures of Leg*†	16	12	4	—	—	—
7	*Neurological Disease*						
	Paralysis agitans	5			—		
	Post encephalitis	1			—		
	Disseminated sclerosis	3			—		
	Lateral sclerosis	2			1		
	Tabes	3			2		
	Paraplegia	4			1		
	Other known diagnoses	3			—		
	Other unknown diagnoses	4			—		
		25	22	3	4	2	2
8	*Miscellaneous*						
	Prostatic disease‡	3			4		
	Chronic nephritis	1			—		
	Diabetes (treated by diet only)	3			—		
	Carcinoma of lung	1			—		
	Recovered from leg sepsis	4			—		
	Paget's disease	1			—		
	Popliteal aneurysm	1			—		
		14	12	2	4	3	1
		182	157	25	38	22	16

* Of 37 continent patients 8 are blind 4 have only one leg and 10 have vertigo Of 8 incontinent patients 3 have vertigo 2 were admitted from municipal homes 3 were neglected or destitute on admission

† Femur (12) tibia and fibula (4)

‡ All with symptoms frequency haematuria or cystitis

§ Mental abnormality here refers to mental changes which do not necessitate constant supervision e g dullness apathy speech difficulty aphasia loss of memory some degree of confusion, wandering

evidence Table XX and Fig 6 give the home facilities now available for each of the four main classes of patient and show that over half have no home The main interest of the table is in the two classes ((*b*) and (*c*)) not considered to require hospital care, of which 39 per cent and 27 per cent respectively have homes to which they could be discharged if the appropriate services were made available This implies that about one-fifth of the present hospital population could be discharged in this way, though in practice some of the patients may not wish to return home even if provided with the necessary facilities for their care

(*d*) *Patients with Gross Mental Change*—About one-fifth of the patients have in common their need for supervision because of gross mental change, and Tables XXIII and XXIV give details of diagnosis for males and females respectively All or nearly all these patients could be certified, but in many cases certification and admission to mental hospitals would be most undesirable

In Tables XXIII and XXIV, classes 2 (mental defect), 3 (psychosis), and 4 (neurological disease) could be regarded as suitable for mental hospitals and no doubt examples of the other conditions specified could also be found in them *Mental hospitals* are not, however, equally happy about the acceptance of all these groups, for example, most hospitals prefer not to take the elderly senile patient Moreover the certification of patients who become abnormal when they are very old, or who suffer from other acute or chronic illness not directly associated with their mental state, is often unacceptable to relatives If institutions for the chronic sick do not survive in their present form, it may therefore be desirable to create separate facilities apart from the mental hospitals for some of the patients in this group

TABLE XIV

DIAGNOSIS OF PATIENTS NEEDING SIMPLE NURSING ONLY, AND CONSIDERED SUITABLE FOR THEIR OWN HOMES OR INSTITUTIONS OTHER THAN HOSPITALS (329 FEMALES)

Diagnosis	Continent			Incontinent		
	No of Cases	Mental State		No of Cases	Mental State	
		Normal	Abnormal§		Normal	Abnormal§
1 *Hemiplegia*	28	25	3	35	21	14
2. *"Senility"**	46	35	11	33	19	14
3 *Arthritis*	44	40	4	19	12	7
4 *Chronic Bronchitis*	17	13	4	11	6	5
5 *Cardiac Failure*	26	22	4	5	1	4
6 *Old Fractures of Leg*†	16	14	2	6	4	2
7 *Neurological Disease*						
Paralysis agitans	5			4		
Post encephalitis	3			—		
Disseminated sclerosis	2			1		
Cerebral syphilis	2			—		
Huntingdon's chorea	2			—		
Cerebellar ataxy	1			1		
Epilepsy	1			—		
Paraplegia (Paget's)	—			1		
	16	14	2	7	5	2
8 *Leg Sepsis and Ulceration*‡	7	7	—	—	—	—
9 *Miscellaneous*						
Diabetes	2			1		
Myxoedema	1			—		
Pernicious anaemia (not having liver)	1			—		
Urinary infection (now recovered)	1			—		
Chronic nephritis	1			—		
Labyrinthine vertigo	1			—		
Vertigo following mastoidectomy	—			1		
Paget's disease	—			1		
Prolapsed rectum	—			1		
Femoral thrombosis (recovered)	—			1		
Diagnosis uncertain	1			—		
	8	6	2	5	2	3
	208	176	32	121	70	51

* Of 46 continent patients 9 are blind 11 were admitted because of vertigo, 10 were neglected or destitute 3 were considered too feeble in a municipal home others had temporary acute illnesses (enteritis urinary infection, lumbago etc.) Of 33 incontinent patients 4 are blind 7 were admitted because of vertigo 5 were neglected or destitute, 2 were admitted from a municipal home because of incontinence 4 because of leg sepsis or ulceration 1 patient was admitted because of constipation (and has been incontinent of faeces ever since)

† Of 16 continent patients fractures are as follows femur (12) tibia and fibula (2) pelvis (1) patella (1) Of 6 incontinent patients fractures are as follows femur (5) tibia and fibula (1)

‡ Healed gangrene, varicose ulcers etc

§ Mental abnormality here refers to mental changes which do not necessitate constant supervision e g dullness apathy speech difficulty aphasia loss of memory some degree of confusion wandering

As one might expect, the mean age is high (Table XXI and Fig 3B) and most patients have been in hospital for a considerable period (36 per cent over three years, Table XXII and Fig 4B) The problems of nursing care are formidable, since only about 10 per cent are ambulant and the great majority are incontinent (Table XXV and Fig 5B)

DISCUSSION

It seems advisable to consider first the limitations of an enquiry restricted to the patients in a hospital for the chronic sick Even if we assume that Western Road Infirmary is typical of other institutions of the same type (and we shall later have data from the Stoke area for comparison), we are unable to offer reliable estimates of the proportion of chronic sick in different age groups in the population as a whole, much less to assess accurately their medical and social needs We are handicapped by the lack of information about the present age distribution of the general population, as well as by the fact that some patients of the same type are cared for in general or mental hospitals or in their own homes

We should recognize a further reason for caution before accepting results based on a cross section of

TABLE XV

DIAGNOSIS OF PATIENTS REQUIRING NO NURSING OR FREQUENT MEDICAL ATTENTION, AND CONSIDERED SUITABLE FOR THEIR OWN HOMES OR INSTITUTIONS OTHER THAN HOSPITALS (41 MALES)*

Diagnosis	Ambulant	
	Indoors Only	Out of Doors
Cardiac Failure (recovered)	2	4
Hemiplegia (recovered)	3	4
Chronic Bronchitis	10	3
Peptic Ulcer (on diet)	1	1
Prostatic Enlargement (admitted with retention)	1	1
Paralysis agitans	2	—
Arthritis	2	—
Old Fracture of Femur (with walking disability)	2	—
Healed Varicose Ulcer (with frequent relapses)	1	—
Post-encephalitis	—	1
Haematuria (cause unknown)	—	1
None†	—	2
Totals	24	17

* Only 3 patients in this group have homes with some facilities for their care they are unwilling to go home, because they believe they would be a nuisance in households with children.
† Two patients aged 72 and 82, admitted with no illness but in a neglected state These are the only patients in this group considered suitable for discharge to the ordinary type of municipal home

TABLE XVI

DIAGNOSIS OF PATIENTS REQUIRING NO NURSING OR FREQUENT MEDICAL ATTENTION, AND CONSIDERED SUITABLE FOR THEIR OWN HOMES OR INSTITUTIONS OTHER THAN HOSPITALS (29 FEMALES)*

Diagnosis	Ambulant	
	Indoors Only	Out of Doors
Cardiac Failure (recovered)	7	3
Hemiplegia (recovered)	3	—
Chronic Bronchitis	3	—
Paralysis agitans	2	—
Old Fracture (with walking disability)	2	—
Carcinoma of breast (no evidence of secondaries)	1	—
Mental Defect (high grade)	—	1
Huntingdon's Chorea	—	1
None	3†	3‡
Totals	21	8

* Only 2 patients in this group have homes with some facilities for their care they are unwilling to return home, because they believe they would be a nuisance in households with children.
† Three patients, considered senile who are old and very feeble
‡ Only two patients aged 65 and 70 could be discharged to the ordinary type of municipal home The third aged 81 was recently admitted from a municipal home because of senility

TABLE XVII

AGE OF PATIENTS REQUIRING NO NURSING OR FREQUENT MEDICAL ATTENTION, AND CONSIDERED SUITABLE FOR THEIR OWN HOMES OR INSTITUTIONS OTHER THAN HOSPITALS (see Fig. 3D)

Sex	Age at Survey (Years)				Totals
	0-59	60-69	70-79	80 and over	
Males	5 (12 2)	12 (29 2)	17 (41 5)	7 (17 1)	41 (100)
Females	4 (13 8)	7 (24 1)	10 (34 5)	8 (27 6)	29 (100)
All patients	9 (12 8)	19 (27 1)	27 (38 7)	15 (21 4)	70 (100)

TABLE XVIII

DURATION OF STAY OF PATIENTS REQUIRING NO NURSING OR FREQUENT MEDICAL ATTENTION, AND CONSIDERED SUITABLE FOR THEIR OWN HOMES OR INSTITUTIONS OTHER THAN HOSPITALS (see Fig 4D)

Sex	Duration of Stay (Months)				Totals
	0-2	3-11	12 35	36 and over	
Males	4 (9 8)	7 (17 1)	16 (39 0)	14 (34 1)	41 (100)
Females	1 (3 5)	13 (44 8)	4 (13 8)	11 (37 9)	29 (100)
All patients	5 (7 1)	20 (28 6)	20 (28 6)	25 (35 7)	70 (100)

TABLE XIX

MOBILITY AND CONTINENCE OF PATIENTS REQUIRING NO NURSING OR FREQUENT MEDICAL ATTENTION, AND CONSIDERED SUITABLE FOR THEIR OWN HOMES OR INSTITUTIONS OTHER THAN HOSPITALS (see Fig 5D)

Sex	Males			Females		
Mobility	Indoors Only	Fully Ambulant	Totals	Indoors Only	Fully Ambulant	Totals
No Continent	24	17	41 (100)	20	8	28 (96 6)
No Incontinent (urine and/or faeces)	—	—	—	1*	—	1 (3 4)
Totals	24 (58 5)	17 (41 5)	41 (100)	21 (72 4)	8 (27 6)	29 (100)

* A woman of 76 years with partial incontinence of urine due to procidentia incompletely controlled by a ring pessary

the present hospital population as an accurate guide to future policy The adequacy of the medical services provided determines to some extent the dimensions of the subsequent administrative problem, for example, the proportion of patients confined to bed or incontinent undoubtedly can be

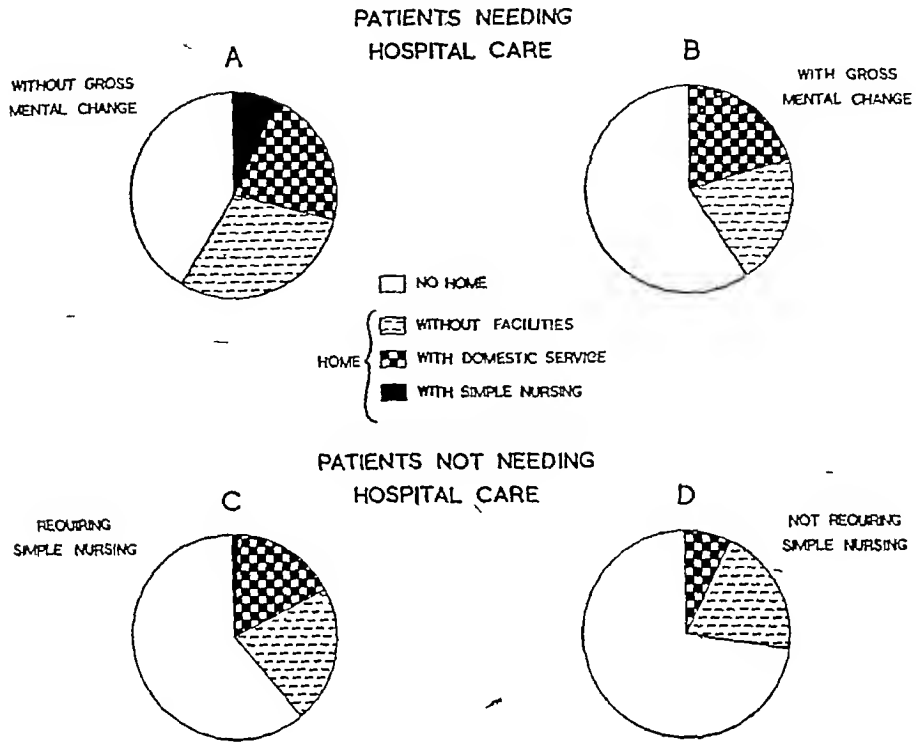

FIG 6 —Facilities available at home (see Table XX)

TABLE XX

FACILITIES AVAILABLE AT HOME (ALL PATIENTS) (see Fig 6)

Home Available	Patients without Gross Mental Change			Patients with Gross Mental Change	Totals
		Institution or Own Home			
	Hospital (a)	With Simple Nursing (b)	Without Simple Nursing (c)	Hospital (d)	
None	78 (41 3)	334 (60 8)	51 (72 9)	117 (59 4)	580 (57 7)
Without Simple Nursing or Domestic Service	56 (29 6)	119 (21 7)	14 (20 0)	40 (20 3)	229 (22 8)
With Domestic Service but without Simple Nursing	42 (22 2)	91 (16 6)	5 (7 1)	40 (20 3)	178 (17 7)
With Simple Nursing	13 (6 9)	5 (0 9)	—	—	18 (1 8)
Totals	189 (100)	549 (100)	70 (100)	197 (100)	1 005 (100)

TABLE XXI

AGE OF PATIENTS WITH GROSS MENTAL CHANGE (see Fig 3B)

	Age at Survey (Years)				Totals
	0-59	60-69	70-79	80 and over	
Males	6 (6 8)	14 (15 9)	39 (44 3)	29 (33 0)	88 (100)
Females	7 (6 4)	16 (14 7)	42 (38 5)	44 (40 4)	109 (100)
All patients	13 (6 6)	30 (15 2)	81 (41 1)	73 (37 1)	197 (100)

TABLE XXII

DURATION OF STAY OF PATIENTS WITH GROSS MENTAL CHANGE (see Fig 4B)

	Duration of Stay (Months)				Totals
	0-2	3 11	12 35	36 and over	
Males	14 (15 9)	24 (27 3)	21 (23 9)	29 (32 9)	88 (100)
Females	9 (8 3)	21 (19 3)	37 (33 9)	42 (38 5)	109 (100)
All patients	23 (11 7)	45 (22 8)	58 (29 4)	71 (36 1)	197 (100)

TABLE XXIII

DIAGNOSIS OF PATIENTS WITH GROSS MENTAL CHANGE (88 MALES)

Diagnosis	No of Cases	Age		Continence	
		Mean	Range	Continent	Incontinent
1 *Senile Dementia only*	*26*	*77 5*	*65-90*	*10*	*16*
2 *Mental Defect*	—	—	—	—	—
3 *Psychosis*	3	68	54-72	3	—
4 *Neurological Disease*					
Post-encephalitis	2	42			
Paralysis agitans	2	67			
Cerebral syphilis	2	68			
Neurofibromatosis	1	66			
Advanced disseminated sclerosis	1	43			
	8	57	37-76	5	3
5 *Hemiplegia*	31	73	54-89	4	27
6 *Other Medical Conditions*					
Cardiac failure	7	80			
Bronchitis	3	82			
Gross arthritis	3	78			
Carcinoma	1	78			
Old fracture	2	74 5			
Leg ulcer	2	76 5			
Ischio-rectal abscess	1	77			
Haematuria	1	79			
	20	78	69-95	6	14
	88			28	60

TABLE XXIV

DIAGNOSIS OF PATIENTS WITH GROSS MENTAL CHANGE (109 FEMALES)

Diagnosis	No of Cases	Age		Continence	
		Mean	Range	Continent	Incontinent
1 *Senile Dementia only*	39	82	74-96	5	34
2 *Mental Defect*	3	60	50-67	2	1
3 *Psychosis*	1	*69*	*69*	1	—
4 *Neurological Disease*					
Post-encephalitis	3	44	42-48		
Paralysis agitans	1	73	73		
Cerebral syphilis	3	64	59 67		
Huntingdon's chorea	2	61 5	61-62		
Epilepsy	1	73	73		
	10	59	42-73	5	5
5 *Hemiplegia*	22	72	53-88	2	20
6 *Other Medical Conditions*					
Cardiac failure	6	76	62-84		
Bronchitis	8	81	74-88		
Gross arthritis	9	80	73-87		
Carcinoma	3	77	74-80		
Old fracture	5	82	78-88		
Gangrene of foot	1	66	66		
Leg ulcer	1	85	85		
Paget's disease	1	62	62		
	34	79	62-88	9	25
	109			*24*	*85*

TABLE XXV

MOBILITY AND CONTINENCE OF PATIENTS WITH GROSS MENTAL CHANGE (see Fig 5B)

Sex	Males				Females			
Mobility	Bed-fast	Sitting out of Bed	Ambulant	Totals	Bed-fast	Sitting out of Bed	Ambulant	Totals
No Continent	13	5	10	28 (31 8)	10	5	9	24 (22 0)
No Incontinent (urine and/or faeces)	58	2	—	60 (68 2)	77	8	—	85 (78 0)
Totals	71 (80 7)	7 (7 9)	10 (11 4)	88 (100)	87 (79 8)	13 (11 9)	9 (8 3)	109 (100)

reduced by better services But although improved services may diminish the proportion of individuals in each age group requiring attention, the proportion of individuals in the general population requiring attention will increase as more people survive to older ages

With these difficulties in mind, we may indicate the conclusions which can legitimately be drawn from this survey We are here concerned mainly with disposal and our suggestions are based on a detailed examination of the medical and social needs of each patient, they make it clear that patients now listed as chronic sick do not form a homogeneous group with consistent medical and social needs As we shall discuss more fully in a later paper, the present hospital population is highly selected in respect of age, marital status, and social circumstances, and it is these features as much as the special nature of their medical problems which in the past have determined their segregation from the acute sick Estimates of hospital bed requirements which have been based on national returns are for this reason misleading, since they ignore the administrative significance of the distinction between two classes of patient commonly described as chronic sick, namely, (1) patients whose illnesses require continuous skilled nursing or medical attention, and (2) patients whose illnesses, though chronic, are characterized by periods of remission in which neither medical nor nursing attention is needed

It is possible to speak with most confidence about the disposal of that section of the hospital population which requires the kind of medical and nursing service provided in a general hospital In our survey, about a fifth of the patients are of this type and they differ chiefly in age from those ordinarily admitted Good reasons have been suggested for caring for the chronic sick in the general hospitals, the most impressive of them being the difficulty of staffing isolated institutions If the proportion of chronic sick whose needs can best be satisfied in general hospitals is not greatly in excess of our experience, this suggestion becomes a practical administrative possibility

It is also evident that patients who require supervision because of their mental state (also about one-fifth in our survey) must be cared for in hospital, the type of hospital is less certain Few general hospitals are equipped for the supervision of this class of patient, and most mental hospitals are reluctant to take them Detailed consideration of the diagnoses indicates that this also is not a homogeneous group, and includes many patients indistinguishable from others already in mental hospitals A decision about disposal could be made more intelligently if similar data were available from mental hospitals For the present, it may be stated that some of these patients could quite properly be admitted to a mental hospital, for others (for example the senile dementias), it may be desirable to create separate institutions We think particularly of elderly senile patients, some of whom require medical attention for illness not directly associated with their abnormal mental state, and whose certification would in many cases distress the relatives

There remain for consideration three-fifths of the patients of the survey who required no medical or nursing attention of a kind or frequency necessitating admission to hospital, and it is by the disposal of this group that most relief can be given to hospitals Clearly from the point of view of the administration, and one hopes of the patients also, no alternative can be as satisfactory as their own homes, where the necessary facilities and assistance are available It is equally clear that in very many

cases these are totally inadequate, and in future local authorities will no doubt insure that no patient leaves his home, or fails to return to it after hospital treatment, for lack of any service which the community can reasonably be expected to provide

Until fuller information is available about the patients on hospital waiting lists, whose personal circumstances are more representative of present conditions, it is unprofitable to speculate on the extent to which the needs of this large class of patients can be met at home It is quite certain that few of those now in hospital can be sent home, since few of them have homes to which they could or would wish to return Moreover, the proportion of unmarried or widowed persons without a home of their own at the time of admission to hospital is high, and indicates that alternative accommodation must be found if such patients are not to continue to fill large numbers of hospital beds If hospitals are to be relieved of that part of the problem which is not essentially their responsibility, it will be necessary to supplement the home services referred to above with institutions which can offer simple nursing or some personal supervision as well as domestic service

Is this the responsibility of regional hospital boards or of local health authorities? It must be remembered that with few exceptions we are discussing the care, not of two separate classes of patient but of the same patients at different stages of illness, their medical and social needs may not always be readily squared with a division of responsibility between several authorities None the less, if we continue to view this as solely a hospital matter, the difficulties will remain as formidable as ever, and will only be relieved by a considerable proliferation of hospital facilities

Because the present position has been greatly influenced by earlier deficiencies in medical and social services, it would be wise to attach significance to the nature of the facilities which this survey suggests, and to let future experience indicate the relative proportions of different types required Although, for the reasons discussed, it is not possible immediately to provide alternative arrangements for many of the chronic sick now in hospital, the evidence suggests that the existing institutions, with their attendant difficulties in staffing and equipment, should not survive in their present form That part of their work which is truly a hospital responsibility can be taken over by the general and mental hospitals, and the remainder by the local health authorities in co-operation with general practitioners and voluntary agencies

Summary

An examination has been made of the medical nursing, and social needs of the 1,005 patients in an institution for the chronic sick transferred to the Birmingham Regional Hospital Board in July, 1948

On the basis of their present requirements, it is suggested that if the necessary facilities were available these patients might be cared for as follows,

1 One-fifth in general hospitals (patients requiring frequent medical attention, or skilled nursing)
2 One-fifth divided between (*a*) mental hospitals and (*b*) other institutions which can supervise patients with abnormal mental states, whom for administrative or personal reasons it may be undesirable to certify
3 Three-fifths divided between (*a*) their own homes, supported by the services of local health authorities, general practitioners and voluntary agencies, and (*b*) institutions, other than hospitals, providing domestic services and simple nursing (washing, feeding, dressing)

Published estimates, based on national returns from hospitals, have put the beds required for the chronic sick at 2 0 to 2 5 per 1,000 of the population If the data given above are typical of other parts of the country, this figure may be sub-divided as follows

1 *Under Hospital Authorities*—0 5 beds per 1,000 of population in general hospitals (about one-tenth of their proposed capacity of 5 0 beds per 1,000 of the population 0 5 beds per 1,000 of population in some type of mental hospital
2 *Under Local Authorities*—The equivalent of 1 5 beds per 1,000 of population in institutions other than hospitals, and in patients' homes

The limitations of data based on the present population in hospitals for the chronic sick are referred to

We have pleasure in acknowledging an indebtedness to Professor A P Thomson, who has contributed to this survey in many ways The medical records were completed by Dr Charman Elkes, Dr S E. Hallissy, and Dr P M Meynell, and the social records by Mrs L. Leaver and Mrs H Pringle, the enquiry owes much to their work, and to the generous co-operation of Dr Nagley and his staff at Western Road Infirmary We are also indebted to Miss Frew, and to those other members of the Almoner's department of the Birmingham United Hospitals, who assisted in a preliminary pilot survey The diagrams used in this paper were prepared by Miss C Wall.

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A STUDY OF THE EFFICIENCY OF GROUPS OF EX-MINERS DISABLED BY PNEUMOCONIOSIS EMPLOYED IN LIGHT INDUSTRIES IN SOUTH WALES

BY

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In order to compare the efficiency of disabled men suffering from coal miners' pneumoconiosis with corresponding groups of other workers, two methods of approach were used an objective approach, comparing the efficiency of a disabled group directly with a corresponding group of fit workers, and a subjective approach, obtaining the opinions of employers about the performance of the disabled men *

The objective method immediately revealed two problems First, what index could be used to measure "efficiency", and, secondly, how could "ex-miners disabled by pneumoconiosis" be defined ? The efficiency of a certain type of labour can be measured most directly by output Unfortunately, in this case it was not possible to use output as a measure of the efficiency of the disabled men, because of the lack, at the time of the enquiry, of firms in South Wales employing a considerable number of such men on individual piece-rates Where piece-rates were paid, they were group piece-rates, and although some disabled men may have been included in the group, output could not be attributed to individuals Most of the disabled men in South Wales were employed on jobs such as store-keeping and labouring, where they were only indirectly productive Consequently, other less direct measures had to be used Absence from work, labour turnover, and accident rates can all be used as less direct quantitative measures of "efficiency" In the objective part of this investigation absence from work has been used as the measure of efficiency There is, of course, no necessary connexion between absence and efficiency on the job, but the two are probably inversely related The nature of the data available prevented the use of labour turnover or industrial accidents as other measures of efficiency

For the purpose of this study some clear-cut distinction had to be drawn between men disabled by pneumoconiosis and all other men The former were defined as those men who had been certified by the Silicosis Medical Board All other men were regarded as being "fit" In view of the fact that in the early stages of pneumoconiosis there may be some uncertainty in diagnosis it is possible that in some cases this definition may have been somewhat arbitrary Nevertheless a line had to be drawn somewhere, and certification had the merit of being precise from the social, if not from the medical, point of view

There is one important corollary to this definition of disabled men Pneumoconiosis cases constitute such a heterogeneous group as far as age and physical disability are concerned, that one might expect the efficiency and absenteeism of such men to vary considerably However, since we are only concerned here with men employed in light industry, we are dealing with a more homogeneous group than the general population of disabled men, since it is probable that the employers would only take on the fitter men

Collection of Data

Absence Records—Despite the fact that there are a large number of certified disabled men employed in industry in South Wales, their industrial distribution is so widespread that the men selected for this investigation were all factory workers employed in light industry, for it proved impossible to find groups of sufficient size in other types of employment

The most obvious method of finding these men in industry was to ask their employers Unfortunately, in many cases, employers did not know which of their employees were disabled by pneumoconiosis The men concerned were sometimes very reluctant to reveal their disability because they believed that they would be dismissed if identified as cases of pneumoconiosis In a factory in

* The term disabled men in this study will henceforth be used as a brief description of ex miners certified as disabled by pneumoconiosis except where otherwise stated

Monmouthshire, for example, the labour manager said that as far as he knew there were no disabled men employed in the factory, yet the factory policeman, in conversation, said that there were several such cases actually in employment there The fact that many of these men remained unremarked was an indirect testimonial to their working capacity but it made their identification a difficult, and sometimes highly delicate, task

A second method of finding these men was provided by the sample inquiries carried out in 1946 by the Social Survey (1946) and Medical Research Council (Stewart, 1948) These samples supplied the names both of the men and of their current employers Lists of names were extracted from these samples and the corresponding employers visited

A third method was used in one factory where the entire labour force was interviewed on the job The information obtained in this way was reliable, but for obvious reasons this direct method could be used only in special circumstances

Only in three factories were enough disabled men found in employment to warrant study In two of them, Factory 1 and Factory 2, the absence records of the disabled men were compared with a corresponding control group of " fit " men In the third, Factory 3, only the absence records of the disabled men were obtained as it was not possible to select a control group there

The precise data obtained at these factories are as follows

In Factory 1 the time lost through absence by each of 37 disabled men employed in 1946, 60 employed in 1947, and 69 employed in 1948 was obtained and compared with the time lost by a corresponding control group of fit men* selected so as to have the same distribution within the group of age, length of employment, and working experience. Consequently, it is hoped that pneumoconiosis constitutes the only essential difference between the disabled and fit groups

In Factory 2 the absence records in 1948 of 26 disabled men (" disabled group ") were compared with those of a corresponding group of 98 fit men (" control group ") from whom were selected, on the same basis as in the case of Factory 1, a true control group of 26 men (" selected controls ") Also, in this factory the absence records of 72 men who had disabilities other than pneumoconiosis were obtained (*'disabled controls"*), and from these again a true control group of 26 men (" selected disabled controls ") was selected on the same basis as before In this way the absence records of pneumoconiosis cases were compared with those of other disabled men

In Factory 3 only the absence records of 53 men disabled by pneumoconiosis were obtained

To make sure that previous mining experience, apart from pneumoconiosis, was not a factor affecting absence from work, a group of ex-miners, none of whom had been certified by the Silicosis Medical Board, were also studied At a store depot, 41 ex-miners who had not been certified as having pneumoconiosis were employed and their sickness absence in 1948 was compared with a selected control group of 41 other workers

Employers' Opinions—The opinions of employers concerning the efficiency of the disabled men they had employed, or were still employing, were obtained from a questionnaire sent to 150 firms in South Wales Besides this, it was found that one firm in South Wales, which employed a number of disabled men, kept careful subjective estimates of the efficiency of all its employees This firm kindly provided these records for some of its workers, and the opinions of the efficiency of the 24 disabled men in employment have been recorded and compared with the opinions about a corresponding control group of fit men

Results

Absence from Work—Before considering the periods of absence found for the different groups of men in the four places investigated, the definition of " absence " must be made clear It was found that all the factories concerned kept their absence records under three main headings (1) sickness absence, by which is meant absence covered by medical certificate, (2) unauthorized absence, by which is meant absence without satisfactory reason being given, and (3) authorized absence by which is meant absence permitted by the factory for reasons other than sickness

Authorized absence, as defined, was found to be of negligible importance so that in the tables of results only sickness absence and unauthorized absence have been recorded

As the absence records of different groups of workers in the four places of employment are to be compared one with the other, it is important that the conditions under which the different groups of men worked were found to be very similar, both within and between each place Likewise, the duration of employment of the men in the various groups was found not to differ greatly In 1948 all four places of employment worked a five-day week of 44 hours and so again they were comparable Lastly, the age distributions of the various groups

* There were more men in the control than in the disabled group in 1946 but equal numbers in 1947 and 1948 The discrepancy occurs in 1946 because although there were originally equal numbers in the two groups the material had to be re-analysed and completed in 1949 by which time some of the factory records were missing. The remaining groups were still well enough balanced for this not to affect comparisons between the groups

of men were taken into account and made comparable at the time of the selection of the cases

The absence records of the different groups of workers in the four factories will now be considered individually

The distribution of the percentage of time at risk which was lost by the disabled and the control groups at Factory 1 is shown in Table I

In Table I and in all subsequent tables the time at risk is the total number of shifts that occurred during the period of study, less the number lost by any form of absence other than that under consideration For example, the time at risk when considering " unauthorized absence " in Table I is the number of shifts worked during the periods shown in each column less absence caused by authorized vacations and sickness absence

It will be seen from Table I that the differences between the distributions of sickness absence and unauthorized absence, for both disabled and the control groups, are very small and it is probable that they would be thought of no account by an employer The average percentage of time lost through sickness absence was smaller in the disabled group than in the controls in each year The average percentage of time lost through unauthorized absence was, however, greater in the disabled group each year, the maximum difference being 0 61 in 1946 The statistical significance of the difference between these mean percentages may be tested, despite the forms of the distributions, by a method devised by Pitman (1937) By a suitable transformation each comparison can be made to give a value for " Student's " statistic " t," which gives in its turn, the probability of differences as great or greater than those being found by a random

TABLE I

FREQUENCY DISTRIBUTION OF PERCENTAGE OF TIME AT RISK LOST THROUGH UNAUTHORIZED AND SICKNESS ABSENCE BY GROUPS OF DISABLED MEN AND CONTROLS IN FACTORY 1

Percentage of Time at Risk Lost	Unauthorized Absence						Sickness Absence					
	Jan 1-Dec 31, 1946		Jan 1-June 30, 1947		Jan 1-June 30, 1948		Jan 1-Dec 31, 1946		Jan 1-June 30, 1947		Jan 1-June 30, 1948	
	Disabled	Controls	Disabled	Controls	Disabled	Controls	Disabled	Controls	Disabled	Controls	Disabled	Controls
No absence	3	4	23	19	18	18	13	19	38	42	39	40
0–	12	15	32	32	34	42	15	22	38	45	39	40
1–	6	13	13	15	17	11	6	7	2	1	3	1
2–	10	7	7	4	9	5	4	—	3	3	6	3
3–	4	2	1	6	3	6	1	—	5	—	6	5
4–	1	3	2	1	1	3	4	2	6	1	—	2
5–	3	—	1	1	—	1	1	3	2	2	1	1
6–	—	—	3	—	1	—	1	1	1	—	4	3
7–	—	1	—	—	3	1	1	3	—	4	2	3
8–	—	—	—	1	1	—	2	—	1	1	—	1
9-	1	—	1	—	—	—	1	—	—	1	2	—
10–	—	—	—	—	—	—	1	1	—	1	4	1
15–	—	—	—	—	—	—	—	—	1	—	—	4
20–	—	—	—	—	—	—	—	1	1	—	—	—
25–	—	—	—	—	—	—	—	—	—	—	—	3
30–	—	—	—	—	—	—	—	1	—	—	—	—
35–	—	—	—	—	—	—	—	—	—	—	2	1
40–	—	—	—	—	—	—	—	—	—	—	—	—
45–	—	—	—	—	—	—	—	—	—	—	—	—
50–	—	—	—	—	—	—	—	—	—	1	—	—
55–	—	—	—	—	—	—	—	—	—	—	—	1
60–	—	—	—	—	—	—	—	—	—	—	—	—
Total	37	41	60	60	69	69	37	41	60	60	69	69
Mean	2 29	1 68	1 50	1 33	1 58	1 26	2 67	3 31	2 01	2 32	3 35	4 97
Upper Quartile	3 0	2 5	2 0	2 0	2 0	2 0	4 5	5 0	3 5	1 0	3 5	6 0
Percentage of the groups with absence	91 9	90 2	61 7	66 7	73 9	83 9	64 9	53 7	36 7	30 0	43 5	42 5

dichotomy of the aggregated group of disabled and controls These probabilities are given in Table II

The probabilities given in Table II are relatively large so that the differences found may well have occurred by chance, and the groups, therefore, may not be differentiated by their absence from work Since, however, the disabled men have a higher unauthorized absence and a lower sickness absence than the fit men in every year (Table I), is the probability of this repeated bias likely to have arisen by chance ? The probabilities of such differences of the given sign can be combined to give a value of χ^2 which can be tested in the usual way

For sickness absence the value of χ^2 is 8 25, which for 6 degrees of freedom, has a probability of between 0 2 and 0 3 For unauthorized absence χ^2 is 11 63, and the probability lies between 0 05 and 0 1 Thus, in neither case does the persistence of the pattern of absence over three years make the difference significant

It may be argued that the mean percentage of absence is not the most useful measure to use, since the employer of labour will wish to know something of the range of absence he may expect The upper quartile, to the nearest half per cent, of each distribution has, therefore, been given in addition. This is the percentage of absence which 75 per cent of the men in each group did not exceed, and it provides, consequently, a measure of the greatest probable absence-rate shown by a majority of them The use of the upper quartile as a measure of dispersion is arbitrary, but it was chosen as being convenient in this case From the upper quartiles given in Table I it will be seen that in the case of unauthorized absence there was no difference between the disabled and the controlled groups, except in 1946, and in the case of sickness absence the disabled men did better than the fit men in two of the years though worse in the third In every case the differences between the quartiles are small

TABLE II

RESULTS OF TESTS OF SIGNIFICANCE ON THE DIFFERENCES BETWEEN THE PERCENTAGES OF TIME AT RISK LOST THROUGH ABSENCE BY VARIOUS GROUPS OF MEN IN THE DIFFERENT FACTORIES

Group	Mean	Pitman's "W'	"t"	Probability
FACTORY 1				
(a) Unauthorized Absence				
1946 Disabled	2 290	0 029	1 524	> 13
1946 Controls	1 681			
1947 Disabled	1 500	0 0023	0 524	> 60
1947 Controls	1 325			
1948 Disabled	1 578	0 0079	1 041	> 30
1948 Controls	1 264			
(b) Sickness Absence				
1946 Disabled	2 674	0 004	0 540	> 59
1946 Controls	3 310			
1947 Disabled	2 013	0 0007	0 286	> 77
1947 Controls	2 317			
1948 Disabled	3 351	0 0085	1 081	> 28
1948 Controls	4 972			
FACTORY 2				
Sickness Absence				
Pneumoconiosis Disabled	5 150	0 03952	1 434	Between 0 2 and 0 1
Select Controls	2 215			
Pneumoconiosis Disabled	5 15	0 02207	1 659	approx 0 1
Controls	2 31			
All Disabled	5 05	0 032818	2 566	approx 0 01
Controls	2 31			

Although the means and upper quartiles of the distributions of percentage absence have been found to be very similar in both the fit and disabled groups, it is possible that a similar total amount of absence could have arisen, in one group through many short absences, and in the other through few long absences The data from Factory 1 in 1946 was analysed from this point of view, and Table III shows the duration of absence, measured by the number of consecutive shifts lost, that occurred in the two opposed groups

TABLE III

FREQUENCY DISTRIBUTION OF NUMBER OF CONSECUTIVE WORK SHIFTS LOST BY DISABLED MEN AND CONTROLS FACTORY 1, JAN 1 - DEC 31, 1946

No of Consecutive Shifts Lost	Unauthorized Absence		Sickness Absence	
	Disabled	Controls	Disabled	Controls
½	11	12	—	—
1	198	152*	4	4
2	16	10	5	9
3	2	4	9	3
4	2	—	8	7
5	—	1	4	7
6	1	—	5	6
7	—	—	5	1
8	—	—	—	1
9	—	—	3	1
10	—	—	1	2
11	—	—	1	2
12	—	—	3	4
13	—	—	—	—
14	—	—	—	1
15–	—	—	2	1
20–	—	—	1	2
25–	—	—	—	1
30–	—	—	—	—
35–	—	—	—	—
40–	—	—	—	—
45–	—	—	—	2
50–	—	—	—	—
Mean Length of Absences	1 11	1 09	5 88	8 13
Mean No of Absences	6 22	4 37	1 38	1 32
No of Men	37	41	37	41

* Including one absence of 1½ shifts

From Table III the distributions in the two groups are again seen to be very similar The mean lengths of unauthorized absences were 1 11 shifts for disabled men and 1 09 shifts for fit men, and for sickness absence the means were 5 88 shifts and 8 13 shifts respectively, so that again where sickness is concerned, the disabled group did slightly better than the controls When the mean number of absences is compared, we find no difference between the groups in sickness absence, but a difference in favour of the fit men of nearly two shifts in the mean number of unauthorized absences (This figure is, of course, related to the mean absence-rate previously obtained, an absence of one shift corresponds roughly to a rate of 0 3 per cent)

We conclude on this limited evidence, that the slightly smaller sickness absence rate of the disabled men is the result of a total number of absences equal to those shown by the fit men but shorter in duration The slightly higher unauthorized absence rate of the disabled is due to a larger number of absences of duration equal to those of the fit men It will be realized that on the whole the number of absences will be of more interest to an employer than the duration of absence, since alternative arrangements must be made whether a man is absent for one shift or eight The differences are so small, however, that no great significance can be attached to them It was not considered worth while analysing the data for 1947 and 1948 in this way

The employee who loses no time at all is obviously ideal as far as absence is concerned, so that the proportion of a group of workers who have periods of absence will be a measure of the deviation of this group from the ideal From Table I once again it will be seen that the two groups of men did not differ significantly, as far as this measure was concerned, in the three years in which we have observed them

It might well be that the absence records of certified men disabled by pneumoconiosis would be affected by the amount and kind of compensation they were receiving Consequently, the group of disabled men in this factory was sub-divided into two groups comprising (1) those in receipt of weekly compensation, and (2) those who had settled their claim to compensation by taking a lump payment These two groups are compared in Table IV (overleaf)

Here the numbers in the total column do not add up to the totals for disabled given in Table I This discrepancy arises because some men settled their claim to compensation during the period of observation and, as a result, could not fairly be classified into either of the two sub-groups and have therefore been rejected It will be seen from Table IV that the mean percentage of the time at risk which was lost through unauthorized absence is similar in both groups for each year On the other hand, the mean percentage of time at risk lost through sickness absence is higher for the group of

TABLE IV

COMPARISON OF FREQUENCY DISTRIBUTION OF PERCENTAGE OF TIME AT RISK LOST THROUGH UNAUTHORIZED AND SICKNESS ABSENCE IN FACTORY 1 BY DISABLED MEN ON WEEKLY COMPENSATION AND "SETTLED" COMPENSATION

Percentage of Time at Risk Lost	Unauthorized Absence				Sickness Absence			
	Jan 1-June 30, 1947		Jan 1-June 30, 1948		Jan 1-June 30, 1947		Jan 1-June 30, 1948	
	Weekly	Settled	Weekly	Settled	Weekly	Settled	Weekly	Settled
No absence	8	17	5	13	13	22	13	26
0–	11	17	11	23	13	22	13	26
1–	3	10	6	11	1	1	—	3
2–	3	4	1	7	1	2	2	4
3–	—	1	1	2	2	2	1	5
4–	—	2	—	1	1	4	—	—
5–	—	1	—	—	—	2	—	1
6–	—	2	—	1	—	1	2	2
7–	—	—	2	1	—	—	—	1
8–	—	—	1	—	—	1	—	—
9–	1	—	—	—	—	—	1	1
10–	—	—	—	—	—	—	2	2
15–	—	—	—	—	—	1	—	—
20–	—	—	—	—	—	1	—	—
25–	—	—	—	—	—	—	—	—
30–	—	—	—	—	—	—	—	—
35–	—	—	—	—	—	—	1	1
40–	—	—	—	—	—	—	—	—
45–	—	—	—	—	—	—	—	—
50–	—	—	—	—	—	—	—	—
55–	—	—	—	—	—	—	—	—
60–	—	—	—	—	—	—	—	—
Total	18	37	22	46	18	37	22	46
Mean	1 36	1 74	1 80	1 45	1 36	2 40	4 40	2 75
Upper Quartile	2 0	2 0	2 0	2 0	1 5	4 0	6 5	3 5

disabled workers who were in receipt of weekly compensation than for the corresponding group who had "settled" their claim in 1948, but it is lower in 1947

In this factory the number of occasions on which a man was late and the number of minutes late were also studied, but, for this purpose, only data taken in 1946 were available These are presented in Table V

The effects of a strike, which caused 32 of the disabled and 30 of the controls to be "late" for 150 minutes and one further man from each group to be late 420 minutes, have been neglected The average number of days on which men were late was 3·3 in the year both for the fit and the disabled group Of those who were late, the average number of minutes lost was 19 44 for the fit group and 24 96 for the disabled There is thus no evidence that the disabled men were more often late, nor, when they were late, were they many minutes later than the controls

TABLE V

FREQUENCY DISTRIBUTION OF DEGREE OF LATENESS OF DISABLED MEN COMPARED WITH CONTROLS IN FACTORY 1 JAN 1-DEC 31, 1946

No of Minutes Late	Disabled	Controls
1–	111	106
30–	9	22
60–	1	2
90–	1	2
120–150	—	2
Mean No of Minutes Late	19 44	24 96
Mean No of Times Late	3 3	3 3
No of Men	37	41

In Factory 3 only disabled men were studied Their sickness absence in 1948 is given in Table VI

TABLE VI

FREQUENCY DISTRIBUTION OF PERCENTAGE OF TIME AT RISK LOST THROUGH UNAUTHORIZED AND SICKNESS ABSENCE BY DISABLED MEN IN FACTORY 3, JAN 1-JUNE 30, 1948

Percentage of Time at Risk Lost	Disabled	
	Unauthorized	Sickness
No absence	12	29
0–	18	30
1–	18	4
2–	2	2
3–	7	5
4–	7	1
5–	1	3
6–	—	2
7–	—	1
8–	—	—
9–	—	—
10–	—	3
15–	—	1
20–	—	—
25–	—	—
30–	—	—
35–	—	—
40–	—	—
45–	—	—
50–	—	1
55–	—	—
60–	—	—
65–	—	—
70+	—	—
Total	53	53
Mean	1 81	3 29
Upper Quartile	3 5	4 0
Percentage with Absence	77 4	45 3

By comparing Table VI with Table I it will be seen that both the means and the upper quartiles of the absence records are of the same order of magnitude We may presume, therefore, that Factory 1, in which the more detailed investigation was made, was unlikely to be a special case in relation to the absence records of disabled men

The absence records of all the groups of men studied in Factory 2 are given in Table VII (overleaf) When we compare the sickness absence records of the pneumoconiosis cases (" pneumoconiosis disabled ") with the corresponding group of fit men (" selected controls ') we find that the mean percentage of time at risk lost by the disabled men is almost twice as great as that lost by the control group The significance of this difference was tested (see Table II) but it was found that a difference of this size could have occurred by chance Thus, in this factory again, we find that the sickness absence rate of the disabled men did not differ significantly from that of the normal worker, but the groups observed were very small and the absolute difference in sickness absence between them was large The small number, therefore, may have been the reason why this difference was not statistically significant

The distributions of time lost through sickness absence of the pneumoconiosis cases were compared with a control group of other disabled workers (" selected disabled controls") and it was found that neither the mean percentage of time lost nor the upper quartiles differed greatly

Furthermore, the pneumoconiosis cases hardly differed in their sickness absence records from the group of other disabled workers (" disabled controls ")

It was therefore concluded that men with pneumoconiosis were not differentiated in Factory 2 in their sickness absence records from men suffering from other forms of disability However, in order to test the notion that the insignificant difference between the absence records of pneumoconiosis cases compared with fit workers might have been due to the small numbers concerned, as discussed above, the absence records of the pneumoconiosis disabled men were combined with those of all other disabled workers (" disabled controls ") and the performance of the total disabled group obtained was compared with the performance of all the fit men When this was done it was found that the disabled men had significantly more sickness absence than the fit workers (see Table II)

This procedure of combining the records of the pneumoconiosis cases with those of all other disabled workers cannot be fully justified, nevertheless, it does suggest that the insignificant difference found between the performance of the pneumoconiosis cases compared with the performance of the fit workers might well have been due to the small numbers in the groups

The results obtained from the investigation in a Store Depot indicated that previous mining experience, apart from pneumoconiosis, was not a factor affecting absence from work For it will be seen from Table VIII (overleaf) that the mean percentages of the time at risk lost by a group of ex-miners without pneumoconiosis compared with a control group of non-miners did not differ greatly, likewise, neither did the upper quartile distributions nor the percentage of workers who had periods of absence differ markedly

Summary of Findings on Absence Data —It may be convenient at this point to summarize the main findings from the absence data presented above

In neither Factory 1 nor in Factory 2 were groups of pneumoconiosis cases found to have significantly more sickness or unauthorized absence than corresponding control groups of normal workers In Factory 2 the sickness absence of the disabled men was greater than that of the fit men, but in Factory 1 the disabled men had actually less sickness absence over a period of three years

A group of 53 men at Factory 3 had much the same absence records as the disabled group in the above factories, which suggests that neither of the two factories intensively studied were special cases

Finally, we have the important observation that the mean percentage of time at risk lost through sickness absence by a group of certified men in three factories did not exceed 5 per cent of their maximum working time and did not fall below 3 per cent, while the mean percentage of time at risk lost through sickness absence by control groups of normal workers in these factories did not exceed 5 per cent and did not fall below 2 per cent

Opinions of Employers —Ninety-two replies were received from the questionnaires that were sent to the 150 firms in South Wales Of these, 44 firms had had experience of employing men with pneumokoniosis

It would be dangerous to attach too much meaning

TABLE VII

FREQUENCY DISTRIBUTION OF THE PERCENTAGE OF TIME AT RISK LOST THROUGH UNAUTHORIZED AND SICKNESS ABSENCE BY MEN DISABLED BY PNEUMOCONIOSIS AND BY CONTROL GROUPS OF NORMAL WORKERS AND OF MEN OTHERWISE DISABLED IN FACTORY 2, JAN 1 TO JUNE 30, 1948

Percentage of Time at Risk Lost	Sickness Absence					Unauthorized Absence				
	Pneumoconiosis Disabled	Disabled Controls	Select Disabled Controls	Controls	Select Controls	Pneumoconiosis Disabled	Disabled Controls	Select Disabled Controls	Controls	Select Controls
No absence	15	40	16	75	20	17	56	18	76	22
0–	15	40	16	75	20	21	66	23	92	26
1–	1	2	—	4	1	5	6	3	3	—
2–	—	—	—	1	—	—	—	—	1	—
3–	1	4	—	4	1	—	—	—	2	—
4–	1	2	—	—	—	—	—	—	—	—
5–	1	—	—	3	1	—	—	—	—	—
6–	—	2	1	1	—	—	—	—	—	—
7–	1	5	3	2	—	—	—	—	—	—
8–	—	1	—	1	—	—	—	—	—	—
9–	—	—	—	1	1	—	—	—	—	—
10–	4	7	3	1	—	—	—	—	—	—
15–	—	7	3	2	1	—	—	—	—	—
20–	—	1	—	2	1	—	—	—	—	—
25–	1	1	—	—	—	—	—	—	—	—
30–	1	—	—	—	—	—	—	—	—	—
35–	—	—	—	—	—	—	—	—	—	—
40–	—	—	—	—	—	—	—	—	—	—
45–	—	—	—	—	—	—	—	—	—	—
50–	—	—	—	—	—	—	—	—	—	—
55–	—	—	—	—	—	—	—	—	—	—
60–	—	—	—	1	—	—	—	—	—	—
65–	—	—	—	—	—	—	—	—	—	—
No of Men	26	72	26	98	26	26	72	26	98	26
Mean	5 15	5 02	4 52	2 31	2 22	0 39	0 24	0 35	0 27	0 12
Upper Quartile	7 5	8 0	7 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0
Percentage with Absence	42 3	44 4	38 5	23 5	23 1	34 6	22 2	30 8	22 4	15 4
Total No of Absences	15	43	15	32	7	10	20	12	31	3

TABLE VIII

FREQUENCY DISTRIBUTION OF PERCENTAGE OF TIME AT RISK LOST THROUGH UNAUTHORIZED AND SICKNESS ABSENCE BY EX-MINERS NOT DISABLED BY PNEUMOCONIOSIS AND BY A CONTROL GROUP OF NORMAL WORKERS IN STORE DEPOT, JAN 1 - JUNE 30, 1948

Percentage of Time at Risk Lost	Sickness Absence		Unauthorized Absence	
	Ex-Miners	Controls	Ex-Miners	Controls
No absence	32	30	30	27
0–	32	30	37	32
1–	—	1	1	5
2–	1	2	1	2
3–	1	1	1	2
4–	—	—	—	—
5–	—	1	—	—
6–	2	1	—	—
7–	—	1	—	—
8–	—	—	—	—
9–	1	—	—	—
10–	1	3	—	—
15–	—	1	—	—
20–	—	—	1	—
25–	1	—	—	—
30–	1	—	—	—
35–	—	—	—	—
40–	—	—	—	—
45–	—	—	—	—
50–	—	—	—	—
55–	—	—	—	—
60–	—	—	—	—
65–	—	—	—	—
70–	—	—	—	—
75–	—	—	—	—
80–	1	—	—	—
Total	41	41	41	41
Mean	4 48	2 00	0 91	0 56
Upper Quartile	1 0	2 00	1 0	1 0
Percentage with Absence	22 0	26 8	26 8	34 1
Total No of Absences	12	15	19	33

to the replies to the questionnaire It is probable that many of the employers had never before considered their disabled employees to be a separate group Their natural reaction to a request to do so, was to say that the disabled men were "quite satisfactory workers" Where the employer already had an opinion on this matter, his opinion was expressed in a more definite way

The general tenor of the employers' opinions was found to be favourable Employers were almost unanimous in the belief that, given certain conditions, disabled men were satisfactory workers The conditions considered to be necessary were (i) that work must not involve heavy lifting, (ii) that there must be good ventilation in the shop, (iii) that heat dust, damp, or fumes are undesirable

Some quotations extracted from the replies to the questionnaire are given below, under the following headings (*a*) comparison with normal workers, (*b*) loss of time by disabled men, (*c*) types of employment suitable for disabled men

(*a*) A factory at Carmarthen employing 12 certified and 8 uncertified disabled men on general labouring duties

"In the main, these men compare favourably with normal workers where employed in a dry atmosphere"

A factory at Pontypridd employing 9 certified and 1 uncertified disabled men on general factory operations

"They compare very favourably The employees concerned are industrious men, diligent, and have adapted themselves well to the various occupations which they have been set."

A factory at Hirwaun employing 7 disabled men as store-keepers, etc

"Favourable, i e the seven men working here have been placed where their particular disability would least affect them, also they are not severe cases"

A factory at Swansea employing 4 certified and 3 uncertified disabled men as general labourers and factory cleaners

"They compare very favourably with normal workers General opinion held by foremen of departments where these men are employed, is that they are good, willing workers, and that their disability does not interfere with the execution of duties With the exception of three silicotics (two of whom are certified) who are more lethargic, all are equal to other employees doing similar work"

A factory at Treforest employing 3 certified and 1 uncertified disabled men as store-keepers and general labourers

They perform ordinary duties quite as efficiently as normal workers The greatest handicap is that they are not able to lift any heavy weight, or even material weighing over a half-hundredweight'

A factory at Dinas employing 5 disabled men

Our observations from a limited experience would show that such cases are indistinguishable from normal workers employed upon light work and of temperamental equality We have found that the incidence of absenteeism of a good type of man of these classes is no greater than any other worker that he can perform any work which does not involve close contact with smoke or

fumes, or the bending and stooping involved in the lifting of heavy weights We have further found it to be helpful that such men be offered work of such a nature and in such a manner that attention is not unduly drawn to any sense of a disability'

A factory in Porth employing 3 certified disabled men

"The men referred to above are employed on machines which require standing up for eight hours a day, but no amount of physical strength We would like to say most emphatically that these men show, in our opinion, a greater amount of keenness and interest in their work than normal men, and are most satisfactory employees in all respects"

(*b*) A factory at Carmarthen employing 12 certified and 8 uncertified disabled men on general labouring duties

"The tendency is definitely more, for these men lose more time than a normal healthy person as far as this factory is concerned"

A factory at Pontypridd employing 9 certified and 1 uncertified disabled men on general factory operations

"No noticeable difference from the general average No wanton absenteeism Average late-coming and sickness"

A factory at Hirwaun employing 7 disabled men as store-keepers, etc

"Varies with degree of disability, but generally fair"

A factory at Treforest employing 3 certified and 1 uncertified disabled men as store-keepers and general labourers

"They perform ordinary duties with practically no loss of time, providing they are kept on light work Any undue exertion will cause them to lose one or more days Their record as far as absenteeism is concerned appears quite favourable, beside that of any of our other male employees The time lost is practically nil"

A factory at Porth employing 3 men certified as cases of pneumoconiosis

"In our experience, these men have never been late or guilty of wanton absenteeism The only observation on this point is that if they do fall ill with ordinary colds, influenza, etc., they are absent from work for a much longer period than normal workers'

(*c*) Although the opinion of employers about what is suitable work for men disabled by pneumokoniosis is not necessarily medically valid, it is none the less of interest to record some of their opinions as examples of the attitude of some potential employers

A factory at Carmarthen employing 12 certified and 8 uncertified disabled men on general labouring duties

"The most suitable employment, in our opinion, is in a dry atmosphere where not too much movement is required and the handling is not of a heavy nature We find that their opinion of what work they can do varies considerably Some appear to work satisfactorily in all kinds of conditions, whereas others cannot, or will not, put themselves out I believe a number could be more gainfully employed if they could get over the thought that they are permanently ill"

A factory at Aberdare employing 5 certified disabled men

"To be engaged on work —(*a*) not heavy, (*b*) not exposed (*c*) not dusty Generally speaking, more than usual normal employment procedure has to be adopted to suit specific cases"

A factory at Porth, employing 4 disabled men

"Mobile employment or some movement desirable Long runs of same type of work desirable"

A factory at Treforest employing 1 certified and 2 uncertified disabled men

'We think that these types of workers want to be living near their work, and should not do long, damp journeys'

A factory at Pontypridd employing 1 man with pneumokoniosis

'In this branch of industry (fancy goods), it should be possible to employ these men on general factory work, on winding machines, and if possessing natural dexterity, on knitting looms and other similar machines. Age, of course, plays an important part in deciding these questions Our man is young, about 24 years old. An old man, with probably more infection, would not give such a favourable picture'

A factory at Treforest employing 3 certified and 1 uncertified disabled men as store-keepers and general labourers

Our experience as far as most suitable types of employment is concerned is limited, but we have found that, given reasonably good ventilation in a shop, and providing that the amount of lifting is not excessive, these men should be able to tackle most types of factory work'

Some further evidence on the comparative efficiency of disabled men was collected from

progress reports kept by a firm at Treforest In this firm annual reports are made on each worker by his foreman and these reports are checked by the senior foreman Marks are awarded under seven different headings —

1	Accuracy	10 marks	
2	Efficiency	10 marks	
3	Industry	10 marks	
4	Adaptability	10 marks	Total 100
5	Loyalty	10 marks	
6	Improvement	10 marks	
7	General Impressions	40 marks	

These reports are used as a basis for promotion The marks awarded to 24 disabled men and to 24 men in a control group were obtained The results are interesting but inconclusive, the small numbers concerned and the subjective nature of these estimates obviously make caution imperative

It was found that the average mark given to the control group was 68 6 and to the disabled group 65 5 There was a considerable difference in the distribution of the marks given under each heading and this distribution is shown in Table IX

TABLE IX

DISTRIBUTION OF MARKS FOR PROGRESS OF MEN DISABLED BY PNEUMOCONIOSIS AND OF NORMAL CONTROLS

Range of Marks	Percentage of Disabled Men in Each Range	Percentage of Control Group in Each Range
1 Accuracy		
1–5	75	58
6–10	25	42
2 Efficiency		
1–5	64	37
6–10	36	63
3 Industry		
1–5	3	17
6–10	97	83
4 Adaptability		
1–5	66	58
6–10	34	42
5 Loyalty		
1–5	—	5
6–10	100	95
6 Improvement		
1–5	79	54
6–10	21	46
7 General		
20–30	100	55
31–40	—	45

The figures in Table IX are presented for what they are worth If any conclusion can be drawn from them it is that, on this evidence, the disabled men in the factory seemed to be less accurate, efficient, adaptable and capable of improvement than those in the control group, but were more loyal and industrious

CONCLUSIONS

Our investigation provides no information about the men more disabled by pneumoconiosis as they will not presumably be found in employment in factories Nor does it permit us to say anything about the performance of the less disabled men when employed in any other circumstances than in light factory work In light factory employment, however, it would appear from the quantitative and qualitative evidence presented that there is no reason to suppose that a group of men with pneumokoniosis would have much, if any, greater absence than a group of normal men This conclusion, of course, may be subject to some considerable margin of error, for men with pneumoconiosis vary greatly as far as their physical disability is concerned This fact makes generalization about the absence performance of the population of pneumoconiosis cases, as a whole, dangerous This is particularly true when the small scope and selective nature of the data used in this paper are taken into account

More confidence can be placed in the assertion that a group of less seriously disabled men will not be absent to such an extent that they will be differentiated by employers in this respect from the rest of their workers This last conclusion is confirmed by the results of the employment questionnaire

SUMMARY

The efficiency of ex-miners disabled by pneumoconiosis who were employed in light factory industry was assessed by comparing their absence records with those of control groups of normal workmen, and also by analysing the opinions of employers about the performance of the disabled men

The absence records in two factories were studied intensively In one of these factories which employed 37 disabled men in 1946, 60 in 1947 and 69 in 1948, it was found that both the sickness and the unauthorized absence of the disabled men did not differ significantly from the absence records of the control groups in these years In the other factory, which employed 26 disabled men in 1948 a similar result was obtained Absence records for disabled men in a third factory were similar to those

in the two studied intensively and this suggested that the latter were representative

The conclusion was reached that it is improbable that a group of pneumoconiosis cases who obtain employment in light industry could or would be distinguished by their employers, as far as absence is concerned, from other normal workers

The opinions of the employers about the performance of the disabled men in light industry were, on the whole, very favourable

I wish to acknowledge the very great help and co-operation which I received, when obtaining the absence data, from the personnel managers of all the factories studied.

I am also indebted to Mr Pierre Gutman of Columbia University and to Mr P D Oldham of the Pneumoconiosis Research Unit for their help with the statistical analyses used in this paper

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VARIATIONS IN ENERGY EXPENDITURE DURING WALKING

BY

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Wide individual variations exist in energy intake as food Our own observations of the calorie values of the diets of Edinburgh University students (Kitchin, Passmore, Pyke, and Warnock, 1949), together with those of Cook (1948) on Dundee students and of Widdowson (1947) on middle class boys before the second world war, are shown in Table I This table is indeed only a quantitative statement of the extent of variations already familiar to all those responsible for feeding young men But, though the variations are well known, the factors responsible for them are not easy to determine Those of the Edinburgh students, we think, cannot be accounted for entirely by differences in external work carried out Thus the survey took place during the winter months when daylight was short and active outdoor exercise was limited to the week-ends For five days of the week, at least, these students could with reason be classified as "sedentary workers"

TABLE I

VARIATIONS IN DAILY INTAKE OF CALORIES BY HEALTHY YOUNG MEN

	Edinburgh students	Dundee students (Cook)	Middle-class boys (Widdowson)
Number surveyed	127	44	20
Age	19-21	17-31	18
Mean daily Calorie intake	2,970	2,878	3,427
Minimum daily Calorie intake	2,140	1,994	2,338
Maximum daily Calorie intake	4,690	3,595	5,221
Standard deviation	518	409	703
Coefficient of variation	17 4	14 4	20 4

However great the variations in physical activity at the week-end, it is hard to believe that this factor alone could account for the wide variations in food intake spread throughout the week of each survey

The possibility exists that those who consume less food are more economical machines, they can go "more miles to the gallon" In carrying out a set piece of mechanical work these small eaters may need less energy than the big eaters To test this hypothesis we have measured the variations in the energy expenditure of a group of 50 young men, half of whom had previously taken part in our diet survey, during the performance of a standard task Walking at a fixed speed was chosen, as it seemed to be the one physical activity which must be common to all and in which all would be in daily training and practice

Any successful correlation between the variations in individual energy intake and output might be expected to throw some light on the important nutritional and social problem of obesity Although in the final analysis obesity is a simple disturbance of the balance of energy, the mechanism and causes of the upset of the balance are far from being fully understood Obesity is the most important nutritional disease in Scotland to-day Our colleague, Dr Meiklejohn, tells us that, judging from his experience in the Dietetic Department of the Edinburgh Royal Infirmary, he guesses that out of the half million citizens of Edinburgh, at least ten thousand are so much overweight as to constitute a serious menace to health Studies in variation of energy utilization may be basic to an understanding of the real cause of the disorders of these people, who, for the most part, cannot be dismissed as simple gluttons

METHODS

Energy utilization was determined by indirect calorimetry using the Douglas bags and Haldane gas analysis apparatus (Douglas and Priestley 1948)

Fifty male students from the physiology class acted as subjects Their ages varied from 19 to 27, the average being 20 years 4 months They formed a homogeneous group, and variations in height, weight, and vital capacity are recorded in Table II Twenty-five had taken part in the diet survey previously reported (Kitchin and others,

* British Council scholar from Buenos Aires

1949), and figures for Calorie consumption over a week were available Unfortunately, the interval between the measurement of dietary intake and energy expenditure was 15 months

For an assessment of basic energy expenditure, oxygen consumption was recorded in a resting condition The routine of the observations was as follows

Volunteers, with whom arrangements had previously been made, reported at 2 p m in the laboratory after the normal 1 to 2 o'clock luncheon break After being weighed and measured, they rested, lying on a couch, for 30 minutes Resting oxygen levels were determined between 2 45 and 3 p m The walking was then carried out on a paved outdoor track The standard pace was 90 metres per minute (3 35 m p h), and this was checked at 20 second intervals No difficulty was found in maintaining a uniform speed Expired air was collected over approximately three-minute periods

All students then carried out the Harvard step test of physical efficiency (Brouha, Fradd, and Savage, 1944) In this the subject steps up and down 30 times a minute for five minutes on to a 20-in stool or platform This is a severe test Those who cannot complete it are given an arbitrary assessment based on partial performance Those who complete the test have an index allotted them on a scale based on measurements of pulse rates during the four minutes subsequent to the exercise

Results

Table II shows the mean range, standard deviation, and coefficient of variation of all our observations Fig 1 is a scatter diagram on which are plotted the rates of oxygen utilization during a standard walk against previously determined Calorie consumption per day The diagram shows no evidence of any correlation Both sets of figures are uncorrected for size We have attempted correlations between figures derived from these basic data in which corrections for size have been incorporated However, we have been unable to derive any evidence of a relationship between the efficiency of energy expenditure and average food consumption This, of course, does not mean that such a relationship may not exist With our methods we have only been able to sample brief periods of behaviour for measurements We can only conclude that such a relationship, if it exists, is not very close and, to demonstrate it, observations on a scale altogether greater than ours would be necessary

Although the main result of these experiments is negative, certain subsidiary points of interest arise In Fig 2, variations in energy expenditure during

TABLE II

Physiological Variations (50 young men)

		Mean	Range	Standard deviation	Coefficient of variation %
Weight (Kg)		66 9	55 80	6 8	10
Height (cm)		174 9	162 189	5 7	3 3
Surface area (sq metres)		1 81	1 60 1 98	0 090	4 9
Vital capacity (litres)		4 8	3 7 6 2	0 26	5 4
Harvard step test (arbitrary units)		73	40 105	15 0	21
Oxygen consumption (ml /min)	Resting	270	209 345	28 1	10 4
	Walking	1,156	920 1,540	124	10 7
Resting metabolism (Calories/sq metre/hr)		42 9	33 9 52 2	4 75	11
Heat output during walking (gm cal /kg /metre)		0 636	0 406 0 795	0 080	12 6

walking are plotted The energy expenditure is calculated in gm.-calories per kilo bodyweight per metre, in line with the classic studies on energy transformation during horizontal walking by Benedict and Murschhauser (1915)

For the base line, estimations of resting metabolism after food have been taken Although theoretically this is much less satisfactory than determination of basal metabolism, practical difficulties arise in measurements of B M Rs on a large scale It is satisfactory, therefore, to find that our determinations for resting metabolism agree well with the findings of Cathcart and Orr (1919) on young infantry recruits These observers found an average B M R of 37 8 Calories per sq metre per hour for the comparable group of young men The increase in lying rate after meals was found to be 12 per cent, giving a figure for a "resting metabolism" of 42 3, with which our figure of 42 9 recorded in Table II, agrees closely Benedict and Murschhauser's observations are very detailed and precise, but cover only two subjects, both professional athletes They found that a change from a lying to a standing position resulted in increases in metabolism of 9 and 10 per cent respectively in the two subjects Our calculations of heat output during walking are made after subtraction of the individual observed value for energy expenditure resting after food

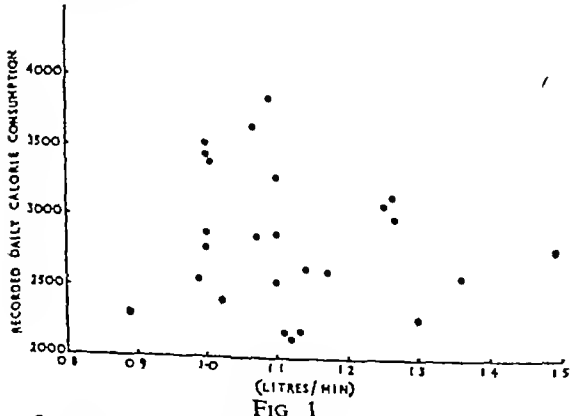

FIG 1

Oxygen utilization walking at 90 metres per minute

The relationships between energy expenditure and weight and height are complex A part of the work done in walking consists in raising the centre of gravity of the body at each step In fact, in expressing energy during walking in gm cal /kilo/metre, Benedict and Murschhauser assumed that with increasing weight an increasing expenditure of energy ensues Our figures do not provide a complete justification for this assumption The correlation between weight and the extra oxygen utilization on walking only gives a coefficient r=0 225 and t=1 59 This is not a significant degree of correlation, although it is suggestive The reason for this is undoubtedly the complex relationship between weight and height and energy expenditure With extra weight there is usually extra height, and this means longer legs, fewer steps, and less raising of the body Unfortunately, we neither measured the length of legs of our subjects nor counted their steps when walking Over the whole height range

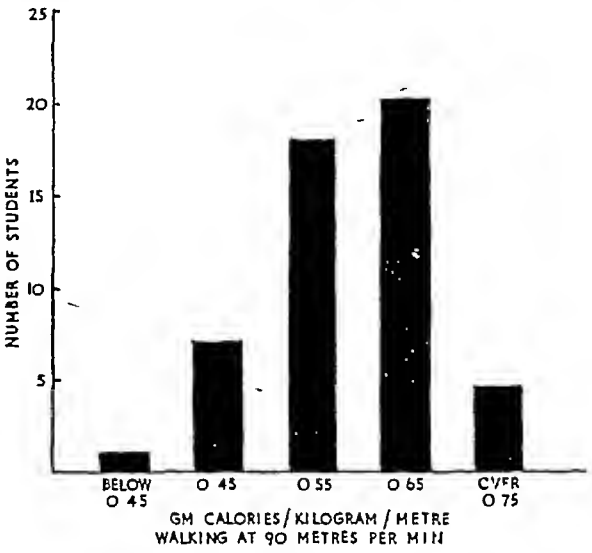

FIG 2

Variations in energy expenditure during walking

our figures show no correlation between height and energy expenditure, but the small men were all above the average figure for energy expenditure expressed in gm cal /kilo/metre Thus nine men in the group with heights below 170 cm (5 ft 7 in) had an average figure of 0 714, compared with the average of 0 621 for those over this height The standard deviation of this difference gives a 't' value greater than 5, and the difference is statistically sound

In walking, with increasing size, more weight has to be lifted but it does not have to be lifted so frequently Thus size would appear to affect energy expenditure in two different directions Our data make it clear that to work out the significance of these changes, observations on a series far larger than our present one of 50 would be necessary

The degree of physical fitness might be thought to affect energy expenditure Of our students, 23 gave Harvard step tests between 65 and 79 and were graded as average Sixteen were above the standard, nine were below it, and two were considered unfit to take the test The test is considered to

compensate automatically for variations in size, and no correlation between performance and height or weight has been found (Selzer, 1946) We found no correlation between the test and walking energy expenditure

Conclusions

These observations on physiological variations in healthy young men emphasize the wide range of normality We feel that these variations in energy expenditure may lie near the root of the problem of obesity and that these further data on their nature are valuable and perhaps provocative

Our observations also re-emphasize the difficulties of drawing up satisfactory tables of dietary requirements based on estimations of energy expenditure on different types of work For instance, the specimen daily tables of energy expenditure drawn up by Orr and Leitch (1937), and used for assessing Calorie requirements, rely for their data in many respects on intelligent guessing Basic information is lacking Hitherto such tables have, of necessity, dealt with a mythical average man Food administrators drawing up ration schedules have perforce to think in terms of such an average man Yet many normal men differ profoundly from the average man With the increasing group control of individual activities in our society, it is important for the individual that the group should know how individuals vary A wider study of such variations in energy expenditure in performing standard tasks would be a useful aid to practical planners The classical methods both of direct and indirect calorimetry, although exceedingly precise in skilled hands, are so laborious and time-consuming that in practice metabolic studies have for the most part been limited to detailed observations on a few subjects When newer methods of sampling expired air and fresh means of estimation of oxygen become available, it may be possible to extend the range of many of our basic observations over a much greater number of subjects, with a correspondingly greater increase in accuracy This would enable much practical food planning to rest upon a sounder basis of scientific data

Summary

The energy expenditure of 50 healthy young men was determined whilst walking under standard conditions The mean value found was 0 636 gm cal /kilo/metre, with variations between 0 406 and 0 795

No correlation could be found between these variations and the previously determined dietary intake of calories

The relation with variations in height and weight and in the Harvard step test for physical fitness is discussed

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REVIEWS

Modern Trends in Public Health. Edited by ARTHUR MASSEY, C.B.E., M.D., D.P.H., D.P.A. 1949. London: Butterworth & Co. Pp. 581 + xi. (£2 10*s*. net.)

Dr. Massey has collected a first-class team and given them the task of expounding modern ideas and practice in public health. The twenty-three essays cover a wide field, and there can be no doubt that the book will become a standard work of reference for all interested in the development of public health, and especially for those about to take up preventive medicine. In no other book will the young medical graduate find such clear statements both of its aims and ideals.

The editor has experienced difficulty in arranging the chapters in any logical sequence, and so has fallen back on the expediency of sending in his contributors in alphabetical order. Under this arrangement the book starts badly, for Dr. K. E. Barlow, who opens with a chapter on "The Idea of a Family Health Club," devotes so much space to expounding elementary biology in a series of clichés that he has little room left to relate either what the Peckham Health Centre has achieved or the Family Health Club at Brandon Woods hopes to do.

In the second chapter, Dr. Fraser Brockington gives an account of "Nutrition and the Public Health." Into thirty-one pages he has packed a mass of accurate information about recent advances, covering biochemical studies, clinical observations, and administrative measures. No one can read this compact review without learning something both novel and interesting.

The third chapter, by Professor F. A. E. Crew, on "Social Medicine as an Academic Discipline," is one of the most important contributions in the volume. The whole history of the academic attitude to preventive medicine is depicted, starting from the writings of Johann Peter Frank (1745-1821) in Germany and a voluntary course given in Edinburgh in 1795 by Duncan *primus*, then Professor of the Institutes of Medicine. The evolution of ideas is illustrated by extracts from standard works of the past and by details of old courses of study for undergraduate and post-graduate instruction. The view is put forward that as an academic study social medicine has advanced but little since the days of the great Prussian liberal politician, Virchow. Preventive medicine in the universities was subsequently almost swallowed by the science of bacteriology. To-day in the universities it is in danger of becoming merely an adjunct to a renaissance of clinical medicine, now in revolt against excessive dependence on laboratory studies. As an independent university discipline, social medicine can only justify itself by studying and expounding how changing patterns of morbidity and mortality affect the structure of human society, and the use of medicine as an instrument of social policy. This interesting thesis appears to the reviewer to have a logical corollary. Of those future leaders of society who will determine the outlines of future social policy, only a small minority will pass through the medical faculties of the universities. Teachers of social medicine would thus be best advised to strive to teach their ideas to students of the humanities in the arts faculties.

In chapter four Dr. Robert Cruickshank gives a workmanlike description of "Recent Laboratory Contributions to Epidemiology." He reviews recent knowledge of the manner of spread of respiratory and intestinal infections, and gives a bibliography of one hundred references.

Dr. W. Edwards gives a delightful account of "General Practice and its Contribution to Preventive Medicine." This chapter should be reprinted and a copy sent to every general practitioner. Dr. Edwards writes pithily and is not afraid of an elegant digression. In an aside on the medical curriculum he hints that the general practitioners of the future might be better at their jobs if, instead of sitting at the feet of a professor of biochemistry, they took a course in the appreciation of fine art. This seems common sense.

In chapter six Dr. William Gunn gives a brief, clear account of "The Future Scope of Infectious Diseases' Hospitals and Associated Services" from the viewpoint of a medical administrator. Professor Johnstone Jervis follows with a forty page, well-documented and well-illustrated review of the smoke problem. This chapter will be a standard reference for many years.

Dr. Kershaw tells the story of "Public Health Nursing", beginning with an account of the Ladies' Reform Association in 1862, and looking forward to the workings of new legislation. The training of the health visitor of the future and the question of specialization is discussed at length.

"Chronic Rheumatism as a Public Health Problem", is discussed by Dr. G. D. Kersley, who gives an excellent account of the present position and a concise summary of orthodox views in Great Britain.

In chapter ten Professor Lane describes a scheme for the teaching of the principles of "Occupational Health in the Universities", both to undergraduate and post-graduate students. This chapter should be studied by every medical faculty and serve as a model to many. Professor Lane ends with a concise statement of the proper aims and objects of a student health service.

Chapter eleven, "The Contribution of Dentistry to the Public Health" by Dr. Lilian Lindsay, is an orderly, clear review of past accomplishments and future prospects.

Professor J. M. Mackintosh writes a brilliant chapter on 'Housing and the Home—The New Outlook.' He describes how houses can and must be built not only to satisfy basic physiological needs for shelter and to supply elementary sanitary appliances, but also to provide a proper stage upon which the social and artistic life of a family can unfold. This chapter is memorable for an elegant translation of an ode of Horace, a thing of beauty in itself and pat to the argument.

In chapter thirteen Dr. A. A. E. Newth describes the "School Health Service", and in chapter fourteen Dr. Doris M. Odlum writes on 'The Mental Health Aspect of Public Health". Both these chapters seem model accounts of present services and their aims and achievements.

In a chapter on 'Health Centres in their Relation to Social Medicine and Public Health' Dr. R. H. Parry discusses the role of health centres in the new public services. He describes existing centres and gives details of administration and structural lay-out.

Sir Leonard Parsons in a chapter on "Child Health and the Universities" gives a fine account of how a university must train its graduates both in preventive paediatrics and in the care of sick children Those whose task it is to build paediatric courses in new universities and those who must renovate old methods of teaching will both find knowledge and inspiration here

The seventeenth chapter, by Dr Hugh Paul, gives a fascinating description of the scope of modern day nurseries and the responsibilities of their medical staff

In chapter eighteen Dr Donald Stewart gives a brilliant statement of the role the doctor can play in promoting occupational health All medical men who are considering entering the industrial field should not fail to read this In it they will find an account not only of the duties and responsibilities of an industrial medical officer, but also of the wide variety of interesting problems which they are likely to meet

Chapter nineteen on 'Vital Statistics—Modern Developments" by Dr Percy Stocks, and chapter twenty on 'Health Education' by Dr Robert Sutherland, are disappointing Or was one surfeited by good things at this stage? Dr Stocks can never be either dull or uninformative, but this chapter seems unnecessarily discursive and it is not quite clear what it is all about Most readers of this book will be in agreement with Dr Sutherland about the need for health education, and would probably have preferred more detailed discussion of the scope and technique, rather than generalizations about aims and objects

In chapter twenty-one Dr Normal Tattersall deals with "Tuberculosis—the Present Position" Statistics and epidemiology, B C G vaccination, chemotherapy, radiology, tuberculosis services, rehabilitation, and the tuberculosis colony, these are all taken in order The story is brilliantly told, and this is perhaps the most exciting chapter in the book

Dr H C M Williams on the "Health Control at the Ports" and Dr G S Wilson on the 'New Organization of *Public Health Laboratory Services*' bring up the rear Both give clear and workman like accounts of these very important organizations

If this review is so overloaded with superlatives that it makes bad reading, this cannot be helped The superlatives must stand It is hoped that they will convey that within the covers of this book is to be found an account of the ideas and institutions of modern preventive medicine in Great Britain Many of the chapters are brilliant examples of hard thinking and clear writing all are authoritative and informative The reader will find here the basis on which public health teaching and services will develop not only in Great Britain, but probably throughout the world

The production of the book is of the standard that we have been lead to expect from the house of Butterworth

R PASSMORE

Women's Occupations through Seven Decades By JANET N HOOKS Women s Bureau Bulletin No 218 United States Govt. Printing Office Washington 1947 Pp 260 Price 45 cents

This Bulletin traces the history of women s work in the United States of America during the past seventy years The author describes in great detail the labour trends in about 450 different occupations Between 1870 and 1940 the number of women at work increased from under two million to over 13 million and their ratio to all workers changed from 1 in 10 to 1 in 5 During the last war, from 1940 to 1945, the number rose to 20 6 million, but quickly dropped again after the end of hostilities to just over 16 million

In 1940, out of 51 million women over the age of 14 in the United States, 11½ million, or 25 per cent, were in work, half a million were in public emergency work, and one million were seeking employment At the same time, 80 per cent of all adult men, or 40 million, were working Miss Hooks rightly points out that the unpaid work of the housewife in her own home should be included in any survey of women's occupations, and states that, if those engaged in housework are included, over four-fifths of all women contributed "to the well being of the nation through either paid or unpaid work"

The sex ratio shows that only in domestic service do women account for more than half the workers, and in this occupation they reach 93 per cent of the total Only in the professions (47 4 per cent), clerical, sales and kindred workers (42 0 per cent), and service workers other than domestic (44 8 per cent) do they account for more than a third, whereas in all others their proportion varies from 2 per cent of all craftsmen and industrial supervisors to 25 per cent of all industrial workers In America, as in this country, the textile and allied trades absorb a large number of working women, and in 1940 54 5 per cent. of all employed women were to be found in textile manufacture, and the making of wearing apparel and fabricated textile goods

The first year in which occupational returns were made for women was 1870 In 1930 the group "home workers" (housewives) was included for the first time The actual number of occupations reached a peak in 1920, when 572 separate jobs were listed In the subsequent amalgamation many obsolete occupations were abandoned, so that today we find no mention in the labour returns of such persons as mantua maker", daguerreotypist", or "hoop skirt maker" Others have lost their identity as, for example, "curriers', tanners", and morocco dressers', who are now all lumped together as 'operatives in leather goods'

The group of clerical, sales and kindred workers, who numbered only 13,000 in 1870, by 1940 had reached the staggering total of 3½ million, including over a million stenographers, typists, and secretaries Women still account for only 54 per cent of all 'office workers" which indicates that they have not replaced men in offices so much as grasped new opportunities The high social status enjoyed by the white-collar" occupations has made them especially attractive to women A meteoric rise has also been observed among the group of "barbers, beauticians and manicurists' who increased by 240 per cent. between 1920 and 1930 This, with the expansion of the amusement industries, is a reflection of the American post-war boom which continued throughout the 'twenties

The census definition of a professional worker has been adopted as one who performs advisory administrative or research work, which is based upon the established principles of a profession or science, and which requires professional, scientific or technical training equivalent to that represented by graduation from a college or university of recognized standing.' Semi professional workers are those in 'a restricted field of science or art, qualified by training or experience or both In 1940 there were 1¼ million women in these groups of whom the two professions of teaching and nursing absorbed 75 per cent Law, medicine, and theology accounted for less than 1 per cent of this group, whereas they included nearly a quarter of all professional men "Teaching has always been the outstanding

professional occupation for women," and in 1940 72 per cent of all teachers were women Between 1870 and 1940 the number of women employed in this field increased tenfold, due, it is suggested, to the widespread replacement of men by women during the Civil War, which placed teaching "overwhelmingly in the hands of women" The number of nurses returned rose from 1,154 in 1870 to over 360,000 in 1940

The first American woman doctor qualified exactly a hundred years ago, and by 1870 there were 544 women physicians and surgeons In the 1940 census the number returned was 20,671, which included "physicians, surgeons, osteopaths, chiropracters and healers and medical workers (not elsewhere classified)" The report-points out that in the medical and quasi-medical occupations there has been an increasing domination of the field by the semi-professional workers such as physiotherapists, masseurs, and chiropodists, and a relative decline in the professional physicians group In the legal profession, although a good many women take their qualifying examinations, a large number do not practice or else use their legal training as auxiliary in some other profession Hence census returns are unreliable and always an underestimate An amusing note relates to the profession of "aviator" In 1910 they were classed as "showmen," and as late as 1940 only 51 women followed this profession—a reflection on the small demand for their services as paid pilots

Many more married women go out to work now than formerly—15 per cent in 1940 compared with only 6 per cent in 1900 They are chiefly to be found in the occupations of domestic service, saleswomen, laundry hands, boarding-house keepers, waitresses, and textile workers

Almost every conceivable occupation is listed, analysed, and related to all the others, and the history of the more important industries in terms of labour force is traced from the late nineteenth century to the present day The author shows considerable insight into the reciprocal influences of occupation and living habits

It is a matter for regret for the non-American reader that so little information is given about the non-white or negro worker Barely a page is allotted to this subject. Only 14 4 per cent. of women in all occupations in the experienced labour force were non-white, of which two-thirds were found in public and private housekeeping, in which occupations they constituted nearly 40 per cent of all those employed

There is a good, selected bibliography on the employment of women, and statistical tables showing decennial employment figures for every occupation or group of occupations from 1870 to 1940 A useful list of current publications of the Women's Bureau is appended As a work of reference this bulletin is valuable provided its limited scope is appreciated We have nothing comparable to it for women workers in Great Britain

CATHERINE SWANSTON

Haven Products A Scottish Experiment in the Employment of Severely Disabled Men By A E TURNER, T A STIRRAT, and T FERGUSON 1948 Published by the Nuffield Provincial Hospitals Trust *Pp* 27 No price given.

The complex interrelationship of the occupational *milieu* with community health is illuminated by this Report It was during the industrial depression of the 1930s that the Scottish Industrial Estate at Hillington came into being. It was a non-profit-making company set up on a Treasury grant, the tenants working under ordinary competitive industrial conditions whilst availing themselves of the services and amenities provided by the Estate Company at an economic rent On this Estate in 1945 the Haven Products set up a sheltered workshop which became the laboratory for a socio-medical experiment in collaboration with industry

The problem of employment of the severely disabled had long vexed the minds of medical and social service staffs at Glasgow, and it was recognized that there were many categories of disablement which must prevent resettlement in purposeful, satisfying, remunerative occupations unless a special environment were created It was decided, therefore, to set up a workshop to employ fifty disabled persons with the possibility of subsequent expansion and perhaps the provision of outwork for the housebound centred on the factory The industrialists on their part accepted the principle of community responsibility for such disabled persons, and the sheltered workshop came into being as a memorial to those who had fought in the cause of freedom A sub-contract on favourable terms was secured for an initial period of three years from a firm engaged in the manufacture of electrically heated pads and blankets The capital required was subscribed by the tenants on the Estate together with contributions from a number of voluntary societies and private individuals, and in 1946 a company was incorporated under the name of Haven Products Limited as a private company to provide facilities for persons registered under the Disabled Persons (Employment) Act, 1944, to have employment and to manufacture electro-thermic quilts, etc

A Medical Advisory Committee was brought into being and arrangements were made whereby every disabled man employed would be medically overhauled Medical supervision was kept as far as possible in the background and the enterprise was run along ordinary industrial lines The various jobs to be undertaken in the manufacturing process were analysed and the requirements for each were made known to the Medical Advisory Committee which was responsible for personnel selection

A wide variety of ingenious contraptions was devised to enable the disabled to cope with their work and with their machines Training allowances for a twenty-six-week period were obtained through the Ministry of Labour, and thereafter a basic wage of 2s 1½d per hour was paid A five-day week was adopted, and recruits were nominated by such bodies as the Cripples League, the Red Cross Treatment Centre, the City Hospitals, and the Ministries concerned The British Red Cross undertook to provide twenty houses nearby for ex-servicemen, and since it is recognized that housing is the cornerstone for any scheme for the severely disabled it is hoped in the immediate future to obtain the means whereby similar houses for the civilian disabled will be provided For the time being transport was provided to convey the workers to and from home

During the first two years forty-eight men were employed, most of them very severely disabled some with severe gunshot wounds of the head or of the spine or suffering from organic disease of the nervous system, some having lost a leg, a few having lost both

The overall absence of workers from all causes amounted to some 7 5 per cent of the total number of working days The output of the workshop was low in the early months, as would be expected but the curve rose gradually to reach a figure of about seventeen production units per man per day

The best testimony to the value of this endeavour is the

striking change that is taking place in the men themselves There has developed a happiness and enthusiasm and a sense of corporate life that is quite unmistakable Failures were exceptionally few, being found among those who had difficulty in adapting themselves to their disabilities or those who suffered from diseases which were overwhelming in their manifestations

This pioneer venture well merits the attention of those who are concerned with community health and who cling to the view that in medicine final social resettlement is the end of therapy. F A E CREW

Studies in Air Hygiene. R B BOURDILLON, O M LIDWELL, and J E LOVELOCK, with W C Cawston, L. Colebrook, F B Ellis, M van den Ende, R. E Glover, A M MacFarlan, A A Miles, W F Raymond, E Schuster, and J C Thomas Medical Research Council Special Report Series No 262 H M Stationery Office London. Pp 356 (Price 7*s* 6*d*)

At least a generation has grown up in Britain in an environment in which the bacterial purity of the water and food supply has been assured by the application of hygienic methods and controlled by statutory regulations The benefits to health have been immense and several once common diseases have become, as a result, comparative rarities No comparable advance has been made in air hygiene Two technical reasons are probably responsible for the delay First there is a much greater quantity of air requiring control than of food and water Secondly, the majority of micro-organisms responsible for air-borne infections will not grow on agar plates, the corner stone of all research on the purity of food and water This report describes basic experiments in air hygiene, which should foreshadow practical advances comparable with those at the end of the last century in water and food hygiene. It covers seven years work by a team of research workers at the National Institute of Medical Research, Hampstead, begun in 1939 under the captaincy of Sir Patrick Laidlaw, carried on under Dr C A Andreas, and completed and expounded under Dr R. B Bourdillon. The report is a model of what a well-integrated research team can accomplish.

Part I deals with methods of sampling air for bacteria, a difficult bacteriological problem. There is the implication that air either free from, or heavily contaminated with, bacteria is probably correspondingly either free from or heavily contaminated with pathogenic viruses Until precise methods of detecting viruses in air become available, this must remain a hypothesis Nevertheless, it is an assumption on which practical policy can be profitably based. Parts II to V deal with air disinfection by chemicals, by ultra-violet radiation, by heat, and by recirculation through filters Part VI discusses the use of masks There follow accounts of field trials in a city hospital, in operating theatres, in a dwelling house, in factories, on a cruiser, and on a submarine Animal tests with infective aerozols are described Finally some general conclusions are given. The findings are not as yet sufficiently clear-cut or concise to be summarized in a few sentences in a review

This report demands careful reading and study by all interested in the prevention of upper respiratory diseases The many authors must be congratulated on the clear manner in which much difficult technical matter has been expressed. There can be little doubt that many of the findings will have far-reaching results on the health of the people

Catalogue of an Exhibition of Books, Manuscripts and Relics commemorating the Bicentenary of Edward Jenner (17 May, 1749-26 January, 1823) 1949 Oxford University Press, Geoffrey Cumberlege London (2*s*)

This catalogue of an Exhibition organized by the Wellcome Historical Medical Museum contains an excellent bibliography of early works on smallpox and vaccination and much other useful information It will be invaluable to anyone starting a study of the history of smallpox or of infectious diseases in general

ABSTRACTS

(This section of the JOURNAL *is devoted to selected abstracts of articles on social medicine appearing in the current literature The section will be edited in collaboration with the two abstracting Journals,* Abstracts of World Medicine, *and* Abstracts of Surgery, Obstetrics and Gynaecology)

Minimal Pulmonary Tuberculosis Its Significance in Relation to the Age of the Patient CHANG, R (1948) *Amer Rev Tuberc*, 58, 612

This study of minimal pulmonary tuberculosis consists of an analysis of 164 cases in patients admitted to Rutland State Sanatorium, Massachusetts, U S A , between 1938 and 1945, all of whom were followed up for at least two years The diagnosis of activity depended on the presence of demonstrable changes in serial radiographs, of tubercle bacilli in the sputum, or of both, with an adequately persistent search, tubercle bacilli were found in 90 7% of the 119 clinically active cases Each case was classified according to the character of the lesion, 20 being described as " recent infiltrates ", 41 as ' fibroid minimal ", and 103 as " mixed " Early infiltrates were found mainly in young patients, fibroid minimal lesions more often in older people—the majority of the latter probably having had tuberculosis long before the diagnosis was made Of the mixed type, 47% were below 25 years of age, 39% between 25 and 38, and 17% over 38 All the cases with persistently negative sputum belonged to the apparently exudative and rapidly resolving type, which is possibly sometimes of doubtful aetiology

The author found that neither the erythrocyte sedimentation rate nor a " shift to the left " could be relied upon to give evidence of activity in minimal lesions An analysis of symptomatology suggested that in older patients the presence of symptoms is of less importance in determining the activity of a lesion than in younger patients, although their absence in the former strongly suggests inactivity Conversely, in the younger patient any symptom should be carefully evaluated and the absence of symptoms in such a case should never be regarded as evidence of inactivity The percentage of active cases was 88 9 in the group below 25 years of age, 71 7 in the intermediate age-group, and 48 8 in the group above 38, progressive disease also occurred more often in younger patients Despite apparently very adequate hospitalization the disease became reactivated after discharge in 17 of the 119 clinically active cases It is argued that immediate hospitalization of the younger patient—but not necessarily of the older patient—is justifiable on diagnosing minimal pulmonary tuberculosis

J V Hurford

Results of Active Diphtheria Immunization with Reference to the Duration of Immunity (Ergebnisse aktiver Diphtherieschutzimpfung im Hinblick auf die Dauer der Immunität) PASCHLAU, G (1949) *Z Hyg Infektkr*, 129 42

A review of the relevant data recorded by non-German workers is supplemented by a survey of the anti-diphtheria campaigns in the pre-war Reich, where a steady rise in the incidence and mortality rate from diphtheria, despite the fact that many millions of children were immunized on a voluntary basis occurred in the 1937 to 1941 period To answer the question whether compulsory immunization reduces the incidence of and mortality from diphtheria, and to ascertain the minimum duration of the immunity evoked by active immunization, an analysis is given of the data obtained in the urban district of Göttingen and five adjacent rural sub-districts where, during five years, 15,598 children of pre-school and school age were inoculated, in addition, the incidence of and mortality from diphtheria were noted among 1,973 non-immunized children in the same area Among the immunized children no deaths occurred, and 162 individuals developed diphtheria (1%), there were 16 deaths among the non-immunized children, (0 81%) out of a total of 160 diphtheria cases (8%), the ratio of incidence among the immunized to that among the non-immunized was during 1942, 1943, 1944, 1945, and 1946, 1 38, 1 11, 1 8 3, 1 10, and 1 8 7 respectively Further analysis showed that active immunization protected for at least 5 years 99% of children of all ages, living in an environment where they were constantly exposed to the danger of diphtheria infection

H P Fox

Rheumatic Infection in Childhood Fifteen to Twenty Year Follow-up Caution Against Early Ambulant Therapy ASH, R (1948) *Amer J Dis Child*, 76, 46

A series of 331 rheumatic children was followed up for 15 years after the onset of the infection, and 150 children for 20 years after onset At the end of 15 years, 55 9% were leading a normal existence, 4 5% were limited in activity, and 37 4% had died of rheumatic infection or bacterial endocarditis Of the 150 children who were followed up for 20 years, 52 6% had died, 41 3% were leading a normal existence, and 3 3% were suffering from congestive heart failure (According to the table 55 3% have died.) The incidence of carditis and of deaths within the first 10 years was greater among those taken ill during the period 1923 to 1927 than during the years 1928 to 1932, and least of all among those taken ill during the years 1933 to 1937 The author argues that the more prolonged period of rest in bed employed in recent years is a more important factor in this improvement than spontaneous changes in the character of the disease (Spontaneous changes in the character of diseases due to infections are so important that it is never wise to make deductions about the effect of treatment by comparing the mortality rate in one period with that in another)

R S Illingworth

Report of a Survey of Children Born in 1941 with Reference to Congenital Abnormalities Arising from Maternal Rubella PATRICK, P R (1948) *Med J Aust* 1, 421

For 129 children born during 1941 in Queensland Australia, and whose mothers had rubella during the pregnancy, clinical findings of deformity and the period of pregnancy at which rubella occurred were tabulated

Of these children 59 were affected, the commonest abnormalities being in order of frequency deaf-mutism, heart disease, mental deficiency, and cataract, singly or in combination The grade of deafness is recorded The following suggestions are made Rubella should be notifiable Girls might be deliberately exposed to the disease Pregnant women exposed to rubella should be treated with immune globulin, although contact of pregnant women with cases of rubella should be avoided as far as possible Termination of pregnancy should be considered if rubella is contracted in the first 4 months Treatment is limited to education of deaf and mentally defective children *Bernard Freedman*

Maternal Rubella and Congenital Defects Data from National Health Insurance Records HILL, A B, and GALLOWAY, T McL (1949) *Lancet*, 1, 299

The authors set out to assess accurately the frequency with which congenital abnormalities appear in the child when rubella or measles has occurred during pregnancy With the help of several approved societies they traced employed insured women who presented a sickness certificate for one or other of these infections, and who, within 12 months, applied for maternity benefit During a period of 2 years 22 notifications were made of such cases, but two of these patients, in whom infection occurred 2 and 3 months before conception, could not be traced In ten cases the details obtained by questioning of the mother suggested that the illness was rubella and in six others measles was diagnosed *In the former* group the illness was estimated to have occurred in the second month of pregnancy in two cases, second or third in three cases, third or fourth in two cases, at the sixth month in one case, at the eighth month in one case, and one month before conception in one case

In all, 17 children were examined, of whom only one presented an abnormality (patent interventricular septum) The mother of this child had rubella at the end of the first month of pregnancy Examination of one child, whose mother insisted that the baby was normal, was refused, the two other children in the total series of 20 had died at 7 days and 5 weeks respectively and in both cases the cause of death was recorded as pneumonia The mothers had had rubella at the sixth and at the second month respectively

The true frequency of the occurrence of congenital defects after infections in pregnancy can only be assessed by first observing the mother during the illness and later noting the condition of the infant, but, as the authors point out, the difficulties of such an inquiry are considerable and even in the space of 2 years very limited information has been obtained from records In their view there should be compulsory notification They conclude that their method lends itself to investigations of this type, and suggest that there should be very little delay in carrying out an examination of the child, in case death supervenes Subsequent visits would probably be necessary *T Anderson*

On Sterility in Finnish Women with Special Reference to its Causes and Prognosis [In English] VEHASKARI, A (1948) *Acta obstet gynec scand*, 28, Suppl 5, 1

The author presents a detailed analysis of 1 690 cases of sterility in Finnish women with particular reference to cause and prognosis This publication contains no new ideas or methods, and is mostly confined to results derived from statistics only [Some of this statistical material is based on methods of examination which would not be considered complete by present-day standards in English fertility clinics Thus insufflation (presumably of gas) was carried out in only 164 cases, and no special examination, other than a simple clinical one, was made in 743 out of a total of 1,690 cases seen Statistical analysis based on such material—only 821 patients had a hysterosalpingography—might well give misleading results, since the author does not appear to be acquainted with recent work on the psychiatric causes of tubal spasm. Thus cases are quoted in which male fertility has not been assessed, showing a higher percentage of tubal factors in the aetiology than in cases in which it has been assessed A psychiatric cause might well account for some of this difference]

The author finds that, of 595 cases of secondary sterility, more than half occurred after abortion In general the male was the cause in 20% The age of highest fertility in women was between 22 and 23 years the average age of women attending his clinic was 32 [This is higher than in most reports published elsewhere] His analysis shows that 55% of women attending with primary sterility had passed the age of optimal fertility The average age of onset of menstruation was 14 7 years, and he concludes that the later the menarche the worse the prognosis An analysis of his findings is given in the following table

		Primary Sterility		Secondary Sterility		Total	
		No of Cases	%	No of Cases	%	No of Cases	%
1	Vaginal factors	25	2 3	2	0 3	27	1 6
2	Uterine	37	3 4	36	6 1	73	4 3
3	Tubal	427	39 0	341	57 3	768	45 4
4	Endometriosis	101	9 2	42	7 1	143	8 5
5	Genital insufficiency	389	35 5	109	18 3	498	29 5
6	Miscellaneous or unknown factors	116	10 6	65	10 9	181	10 7

[There are some curious omissions in this analysis The author does not mention (page 29) faulty sexual technique as a cause of sterility, yet it is frequently observed in fertility clinics that because of ignorance penetration often has not taken place Also (page 34) he considers anatomical retroflexion a cause of sterility—a view not generally accepted in Britain Psychiatric factors should not be excluded nor should that group of cases in which pregnancy occurs before any treatment is actually started It is believed that emotional tension producing tubal spasm may be the causative factor, and that a visit to the doctor relieves that tension It is clear that the author accepts the radiographic appearance of a tube as final but recent observations have shown that repeated hysterosalpingography may demonstrate the presence of patency in a tube at first apparently blocked No account is given of artificial insemination, and it is clear that this method of treatment has not been widely used In general, although this paper is very carefully worked out, some of the results may be misleading because of the inadequacy of the investigations undertaken]
B Sandler

Causes of Error in Statistics of Sterile Marriages (Causas error en estadisticas de parejas estériles) GUERRERO, C D (1948) *Ginec Obstet Mexico* 3, 107

In a study of 438 sterile marriages in Mexico the author found that successful results were obtained from treatment in only 10 1%, and that the percentage was not

increased with more experience and better methods A detailed analysis of 100 cases studied in 1945 has therefore been made There were 74 cases of primary sterility and 26 of secondary sterility The average age of the patients was 28 6 years, and the average period of sterility 5 4 years Thirty-nine patients were referred by other doctors, and 63 had been previously treated A full investigation of the wife by modern methods, and of the husband, as far as possible, was carried out

The four main factors causing sterility may be classified as tubal, hormonal, cervical-spermatic, and pure spermatic Cases may be further divided into serious and not serious The serious cases are difficult to treat or incurable, and include those of azoospermia, bilateral absence or obstruction of the tubes, and non-secreting endometrium In 64 serious cases the success rate was 4 56%, in 24 not serious cases it was 41 8%, and for the whole series 14 5%

The specialist in sterility problems has sent to him many difficult cases which have already had treatment and are often incurable, and unless this is sufficiently understood the speciality will lose prestige Comparison of the results of methods of treatment is also impossible without a standardized classification such as that described *Bryan Williams*

Habitual Abortion A Pathologic Analysis of 100 Cases WALL, R L, and HERTIG, A T (1948) *Amer J Obstet Gynec*, 56, 1127

The authors make a well timed appeal for a more rational treatment of habitual abortion according to the cause shown by systematic examination of mother, ovum, and placenta Of 100 cases, 58 were found to have the same aetiology, the commonest factors being pathological ova (36 cases) and uterine abnormalities (8 cases), the least common factors were foetal anomalies (2) and inflammatory conditions (3) In a control series of 1,000 spontaneous abortions the aetiological factors were discovered in approximately the same percentages, leading to the conclusion that any woman who aborts is a potential habitual aborter, and the corollary that the first abortus of any patient should be thoroughly examined pathologically, to enable patient and physician to become intelligently prepared" for a subsequent abortion This evidently entails a belief in 'specific' therapy, such as the use of endocrines in apparently forestalling the production of pathological ova, and of vitamin E in preventing foetal anomalies [The latter, occurring in only 2% of the habitual abortion series, are worth remembering] *A F Anderson*

The Incidence of Eclampsia in Wartime (De frequentie van eclampsie in oorlogstijd) MASTBOOM J L (1948) *Ned Tijdschr Geneesk*, 92, 3604

Statistical evidence collected in Amsterdam confirms the findings of other workers in other parts of Holland, emphasizing once again the decrease in incidence of toxaemia of pregnancy in wartime To meet a well-known objection the higher frequency of eclampsia in primiparae is taken into account, without altering the final conclusion An analysis of data obtained in various belligerent countries during the first and the second world wars shows that the decrease in incidence is fairly constant There is still a heated controversy as to the reasons for this lower incidence and various causes such as low salt or low protein consumption were indicated A closer analysis of the diet of pregnant Dutch women during the war years shows that though the total Calorie intake was reduced no single nutritional factor was particularly deficient The author believes that the over-all low food intake is the cause In support of this hypothesis he mentions another significant fact a fall during the war years in the average blood pressure affecting also pregnant women (I S Sindram, 1943, *Ned Tijdschr Geneesk*, 87, 1414) A low blood pressure indicates a lower vascular tonus, and it is suggested that a variation in the tonus affects the irrigation of the intervillous spaces—an important factor in the development of toxaemia of pregnancy *A Lilker*

Diet Studies in Pregnant Patients DIECKMANN, W J, TURNER, D F, MEILLER, E J, STRAUBE, M T, GROSSNICKLE, K B, POTTINGER, R E, HILL, A J, SAVAGE, L J, FORMAN, J B, PRIDDLE, H D, BECKETTE, E S, and SCHUMACHER, E M (1948) *Obstet gynec Surv*, 3, 731

The authors began their present study of the diet of pregnant women in September, 1946, and it is still being continued it is hoped that eventually the investigation will include 1,000 patients The present report is a preliminary one and describes the methods used to secure an accurate dietary record during pregnancy No attempt has yet been made to study the effect of a controlled diet on pregnancy, but it is hoped that eventually the results of these investigations will be pooled with those of other institutions and definite conclusions reached based on an adequate number of patients

Each new patient seen within the first 4 months of pregnancy is interviewed by a dietitian and provided with a 500 g scale, which she is taught to use She is then asked to keep a complete record of everything eaten until the next visit 2 weeks later At the second visit a diet is recommended containing 85 g of protein with the other constituents in appropriate amounts For the remainder of pregnancy she is asked to weigh and record her food intake during five or six 2- or 3-week periods All patients are instructed initially to take a basic diet of 1,800 Calories, but if gain in weight is excessive the caloric intake is reduced to 1,500 or 1,200 Laboratory and clinical data are being recorded on these patients but only the protein intake of the diet is being calculated Records however, will be available for calculation of all the minerals and vitamins Up to December, 1947 875 patients had been included in the study, but 29% of these had had to be excluded because they were unable to follow the instructions given or to keep reliable dietary records *R L Hartley*

Maternal Mortality in Clinical Obstetrics, Causes and Dependence on Circumstances of the Time (Müttersterblichkeit bei klinischer Geburtshilfe, ihre Ursachen und ihre Abhängigkeit von den Zeitumständen) WOLFHAGEN O (1948) *Z Geburtsh Gynäk* 129 242

The author differentiates primary clinical deliveries from secondary clinical deliveries In primary delivery there was no antenatal care or treatment while in secondary delivery there had been either previous examination or treatment Amongst 42 858 deliveries between 1915 and 1946 at the University Clinic for Women Hamburg there were 228 maternal deaths 153 directly due to pregnancy and 73 due to associated causes Of 161 deaths, 69 were primary 92 secondary 53 due to eclampsia 19 due to placenta praevia three due to accidental haemorrhage and seven due to rupture of the uterus

A definite decline in the death rate from puerperal

sepsis was noted This was independent of war conditions Embolism showed decrease during the war period 1914-21 and an increase during peacetime The decline in number of cases of embolism was thought to be due to a decrease in obesity The fluctuations in number of cases of post-partum haemorrhage showed no relation to peace or war, but the amount of blood lost was greater during wartime and thus the number of deaths due to this cause increased This was thought to be a consequence of changes in the autonomic nervous system due to mental and material stress The number of cases of obstetric shock showed no relation to war or peace

J Tintner

The Biological and Clinical Significance of the Early Onset of Menstruation The Acceleration of Development of the Young in the Pre-war Era (Die biologische und klinische Bedeutung des frühen Menarchetermines Zur Entwicklungsbeschleunigung der Jugend in der Vorkriegszeit) TIETZE, K (1949) *Z Geburtsh Gynäk*, 130, 273

The author has made an extensive study of the biological and clinical significance of the early onset of menstruation in adolescence. He comes to the conclusion that the accelerated development of the young generation, shown by the advance of menarche from an average of 14 5 to 15 years at the beginning of the century to an average of 14 years now, may almost be spoken of as an evolutionary phenomenon The author thinks that it is of an endogenous character and that it varies exogenously Clinical tests have failed to elicit any proof that early menarche—at least in so far as the functional efficiency of the female is concerned—results in increased morbidity Nor is there any good reason to consider the advance of menarche an unfavourable biological variant.

The results of accelerated development lie in a different sphere altogether The period between the onset of puberty and the average age of marriage is prolonged, the sexual functions are active in girls hardly out of childhood, so that they are made to realize the facts of life and must adapt themselves to them often much sooner than is desirable This may lead to far-reaching consequences, and it is the task of the parents and of the educationists to give guidance The entire problem of accelerated development of youth and all other problems connected with it demand attention, more especially in view of the significance of the accompanying circumstances, mainly of a psychological and sociological nature, they are thus out of the sphere of activity of the physician, who merely plays the part of an adviser to parents, educationists, and magistrates at juvenile courts

I Bierer

Erythroblastosis Fetalis in Negroid Infants WIENER, A S, and WEXLER, I B (1948) *Blood*, 3, 414

The incidence of erythroblastosis foetalis among Caucasoid populations is believed to be between 1 in 400 and 1 in 150 births If the Rh factor were of equal importance in the aetiology of erythroblastosis in the two ethnological types, it might be expected that the incidence of the condition among negroes would be from one-third to two-thirds of that found in Caucasoids. In fact, however, erythroblastosis is rare in negroid infants The authors present clinical and haematological histories of three such infants, on whom a diagnosis of erythroblastosis foetalis was made In two of these cases the condition was proved to be due to sensitization of the mother to A and B factors, while in the third instance no isosensitization of the parent by an antigen in the foetal blood could be demonstrated. Rh sensitization was not present in any of the cases reported The suggestion is made that in the negroid races either the placenta offers a more complete barrier to the passage of materials from foetus to mother, or susceptibility to sensitization with antigens of foetal origin is low in these peoples

H Payling Wright

Results of the Nationwide Study of Penicillin in Early Syphilis (A Report of the Central Statistical Unit) I Amorphous Penicillin in Aqueous Solution MERRELL, M (1949) *Amer J Syph*, 33, 12

Approximately 7,000 patients are included in this analysis Seven treatment schemes, with doses of 300,000 to 800,000 units of penicillin, were used In the majority of cases the drug was given 3 hourly over 7 5 days About a year after treatment at least 10% of patients had a clinical relapse or re infection At 15 months the patients treated with the lower dosage of penicillin showed a clinical relapse rate of up to 25%, whereas the highest doses used yielded a 12% relapse rate It is noted that the clinical relapse rate was steadily rising over the entire period of observation, but the author has not attempted to exclude re-infections The total failure rates, which included both clinical and serological failures, were 1 5 times as large as the corresponding rates based on clinical failures only It is concluded that even of the earliest cases of syphilis treated with the highest dosage schedules 10% will relapse at the end of the first year

G W Csonka

II Amorphous Penicillin versus Crystalline Penicillin G, and Aqueous Penicillin versus Penicillin—Oil—Beeswax RIDER, R V (1949) *Amer J Syph*, 33, 19

When treatment by amorphous penicillin was compared with that by crystalline penicillin G no significant difference in the number of clinical relapses was found, but when serum resistance and serum relapses were taken into consideration as well the results obtained from crystalline penicillin G appeared to be superior at the end of the observation time of 14 months The doses employed were 2,400,000 or 4,800,000 units over a 7½-day period, injections being given 2- to 3-hourly There was, however, no difference, so far as results were concerned, between 2,400,000 and 4,800,000 units of G, or the 2- and 3-hourly intervals between injections In comparing penicillin in peanut-oil-beeswax and penicillin in aqueous solutions two series were used—one with 4,800 000 units, the other with 9 600,000 units No difference in failure rate was observed between the two drugs in either series This bears out the earlier favourable results recorded with penicillin in oil beeswax

[This and the previous paper give important statistical evidence of the value of penicillin as a sole agent in the treatment of early syphilis, and for details the original papers should be consulted As the treatment 'failures' include an unknown number of re infections the true picture may be more favourable] *G W Csonka*

Penicillin Syphilotherapy Administered Prior to Pregnancy A Study of 111 Pregnancies during which Additional Antisyphilitic Treatment was Withheld TUCKER, H A (1949) *Amer J Syph*, 33, 1

The author reports 111 pregnancies in 88 women in which no treatment of syphilis was given during pregnancy 72 of the patients had primary or secondary syphilis, and of the remainder latent or early asymptomatic neurosyphilis The majority received 3 000,000

units of aqueous penicillin every 2 or 3 hours for 7½ to 15 days At the time of delivery 30 mothers were serum positive There was only one congenitally syphilitic child born, giving an incidence of 0 9% It is concluded that giving penicillin in excess of 2,400,000 units to a syphilitic woman, whether pregnant or not, with satisfactory response, is sufficient to guarantee healthy offspring in subsequent pregnancies, provided relapse or reinfection does not occur Each patient should be observed monthly throughout every pregnancy, in order that re-treatment may be given promptly in the event of a positive serum reaction, serum resistance in high titre, clinical relapse, or reinfection In the author's experience the incidence of infantile congenital syphilis has already been reduced to a fraction of that seen before the advent of penicillin

[It is open to question whether re-treatment should be withheld at a stage of syphilis when the relapse rate after optimum treatment may be as high as 10%]

G W Csonka

Forecasting the Incidence of Neurosis in Officers of the Army and Navy MAYER-GROSS, W , MOORE, J N P , and SLATER, P (1949) *J ment Sci* , 95, 80

An attempt was made at Crichton Royal, Dumfries, to assess the reliability of 16 different pointers in forecasting the incidence of neurosis in officers of the Army and Navy These pointers were heredity, previous ill-health, neurotic traits in childhood, former psychiatric illnesses, defective intelligence, adolescent shyness, adult shyness, temperamental instability, obsessional features, apprehensiveness, undue dependence in childhood or later life, unstable work record, sexual difficulties, alcoholism, head injuries, and accident proneness The cases investigated comprised 101 naval officers, 100 army officers, and 55 " normal " controls from a mobile army division The average numbers of pointers in the various groups were naval neurotics 4 50 (range 0 to 10), army neurotics 5 96 (range 0 to 12), and controls 0 93 (range 1 to 7) The authors prefer not to express any opinion on the causes for the discrepancy between the figures for the army group and those for the naval group Discharged neurotic patients had a significantly higher average number of pointers than those retained in the Service (6 92 and 5 34 respectively) By a specially adapted method of factor analysis, combinations of pointers were studied and 3 main divisions separated off, a main class indicative of inadequacy, a second class indicative of instability, and a third class indicative of shyness

D S Fairweather

Morale and Flying Experience Results of a Wartime Study STAFFORD-CLARK, D (1949) *J ment Sci* , 95, 10

'Flying stress" became as ambiguous a phrase as 'shell shock" and 'D A H" Symonds established its permissible use as a description of the stresses to which the flying man is liable rather than of the reactions which he shows

The present author describes the particular nature of the stresses involved by the operations of Bomber Command Most lucidly does he show how morale was built up and graphically records what might be termed the 'normal' reactions to stress before discussing the more abnormal aspects As against a casualty rate for killed and missing of about 48%, and one for killed, missing, wounded and injured of about 64%, the rate of " nervous breakdown " was less than 5% This is indicative of the extraordinarily high level of morale Breakdown might or might not be complex, involving domestic problems, financial anxiety, or worries relating to parents, but of supreme importance were the physical realities of violent death

The conflict between the sense of duty and the instinct of self-preservation was clear The physician's duty involved consideration not merely of the patient's welfare, but also of repercussions on the morale of the unit Four main types of breakdown occurred (A) at the beginning of bomber operations, (B) in the middle , (C) in the last four or five sorties, and (D) as the result of exceptional stress Prognosis was worst in the first and fourth types The main characteristics of each group may be summarized as follows (A) essentially unwilling to fly, anxiety states predominating (B) developing symptoms, especially anxiety, after the eighth or ninth operational sortie, and in need of reinforcement of resolution, (C) developing symptoms due to fatigue and anxiety, showing temperamental lability, and in need of adequate rest and change, (D) after a single appalling experience, accompanied by horror and great distress, in need of sound sleep and continuous unobtrusive supervision

The 46 cases studied are classified as cases of anxiety (31), hysteria (5), depression (4), fatigue (2), and loss of confidence (non-medical) The figures are comparable to those given by Symonds and Williams (F P R C 412 (9) included in Air Publication 3139, H M.S O) in an analysis of 1,197 similar cases A graph is drawn to illustrate successive fluctuations in the morale of normal men

D S Fairweather

Cardiovascular Rejectees A Follow-up Study WHITE, P D , LEVY, R. L , KERR, W J , STROUD, W D , and FENN, G K (1949) *J Amer med Ass* , 139, 1049

Re-examination in 1943 of 4,994 men previously disqualified by local boards from general military service in the U S armed forces because of suspected cardiovascular defects enabled 863 to be regraded as fit for service, 447 of whom were accepted The chief diagnostic difficulties arising at that time lay in the interpretation and assessment of apical systolic murmurs, in the definition of the limits of normal blood pressure, resting pulse rate, and heart size in relation to body build, and in the evaluation of results of exercise tests and electrocardiographic findings, while there was some doubt as to the desirability of rejecting men with a diagnosis of neurocirculatory asthenia, or a history of recent rheumatic fever without evidence of cardiac disease The present (1947) follow-up study of 303 of those men who had been regraded as 1A in 1943 was carried out in order to assess the effects both of the war and of post-war adjustment on their cardiac condition

At least 50% still had trivial heart murmurs four had developed rheumatic heart disease since 1943, but in those who gave a history of rheumatic fever in childhood or early life without demonstrable sequelae in 1943, recurrence of activity between 1943 and 1947 was distinctly uncommon' There were no significant changes in heart size with the exception of four men who had developed definite enlargement one of whom was hypertensive the others apparently healthy Of 67 men with transient hypertension at their first examination 33 now had normal readings 17 still showed transient hypertension and 17 had developed sustained hypertension Another ten whose blood pressure was normal

in 1943, now had sustained hypertension, and 13 had developed transient hypertension No conclusions could be drawn from analysis of the pulse rates The electrocardiogram had become abnormal after 4 years in only one case, and seven men were thought in 1947 to have neurocirculatory asthenia which had not been diagnosed in 1943 The authors conclude that these 303 men, in general, "served long and well in the Armed Forces," and few were discharged for cardiovascular reasons

J L Lovibond

Some Public Health Problems in Nuclear Fission Operations GORMAN, A E, and WOLMAN, A (1949) *Amer J publ Hlth*, 39, 443

The United States Atomic Energy Project, which has grown so enormously in such a short time, has created sanitation problems of immense importance to public health These problems are such that well-established hygienic principles are applicable only up to a point many new lines of approach had to be sought. New methods have been evolved to protect the health, not only of very considerable numbers of people engaged on the project, but also of the general public The impact of this new industry will undoubtedly be felt by whole nations

This paper is a broad appraisal of the health implications of nuclear fission and its sequelae It embodies a clear exposition, in non-technical language, of the facts relating to the project Emphasis is laid upon the need which now exists for training sanitation workers in these new aspects of their task Large communities of people have been gathered into formerly sparsely inhabited regions Thus, at the outset, a formidable problem in housing, drainage, sanitation, and water supply is presented, and to this must be added the effect of building large chemical and engineering plant of great complexity and novel design The processing of uranium on a vast scale involves new industrial health hazards because of radioactivity, at the same time creating grave problems of effluent disposal The uranium pile itself is an entirely new type of plant in which a nuclear 'chain reaction" is maintained Radiations of unprecedented intensity are evolved in the process, and the end-product is plutonium, a dangerously radioactive metal, recently created and not found in nature Intermediate 'fission products", highly radioactive and often gaseous in form, demand disposal A water-cooled pile requires enormous quantities of water, and its effluent is heavily contaminated with radioactive substances Similarly, an air-cooled pile contaminates great volumes of air, thus creating a serious problem requiring the co-operation of meteorologists Pile operatives have to be highly trained, carefully protected by shielding and remote-control devices, and kept under strict medical surveillance The new science of health physics has rapidly reached a high degree of specialization Monitors" use electrical counting and measuring instruments to estimate radiation, and their task is to restrict the exposure of personnel to within various tolerance limits laid down by research workers The manufacture of radioactive isotopes is no mere scientific curiosity but is a growing commercial concern, their applications in industry are even wider than in medicine

Atomic energy and its implications must now be considered in any large-scale public health plan The hazards of radioactivity will eventually command almost as much attention as those of infection, and must be included in the province of the sanitary engineer and public health expert

T E Graham

A Nutritional Survey in Pregnancy with Particular Reference to Certain Haematological and Biochemical Findings HOBSON, W, LEWIS, F J W, and WOODMAN, D (1949) *J Obstet Gynaec Brit Emp*, 56, 217

This survey was carried out in Bristol on a large group of primiparae by means of the 'individual weighing method", which gives information of the mean minimum and maximum intake of every article of diet and of its every chemical constituent The findings were correlated with the subsequent clinical history

No correlations were found between protein intake or quality of the diet and serum protein level, between calorie intake, protein intake, or quality of the diet and the birth weight of the baby, between iron intake and haemoglobin level, or between serum protein level and birth weight or incidence of toxaemia The diet in the group was better than before the war Thus the mean intake of protein was 90 g per day, or 1 5 g per kg. body weight In terms of animal protein the diet was also better than the pre-war diet, the mean value being 50 g as compared with 43 g found by McCance, Widdowson, and Verdon Roe (*J Hyg, Camb*, 1938, 38, 596) The mean dietary intake of iron was 14 mg. per day compared with 12 mg in 1938 (McCance and others), and there was no evidence of iron deficiency in the group as a whole The authors attribute these improvements to the fall in unemployment from 1939 onwards, the introduction of National flour in 1942, and the various diet priority schemes for expectant mothers introduced from 1941 onwards

F J Browne

Prenatal Maternal Factors in Mongolism BENDA, C E (1949) *J Amer med Ass*, 139, 979

Two previous studies, of 250 and 75 cases of mongolism, have been published and this report deals with a further 50 cases tabulated according to maternal age, the latter ranging from 52 to 21 It is maintained that mongolism increases with advancing maternal age, and that the mongoloid child is found near the end of a line of siblings Two or more mongoloids are found only in families of over six children The theory that mongolism develops from fertilization of an over-aged' ovum cannot be excluded, though later extrinsic factors seem of more importance A threshold condition of hormonal sterility exists, in which the maternal organism is unable to produce the proper endocrine environment for the embryo This may be due to an approaching menopause, or to insufficient response to fertilization in women under 30 years, or in primiparae In addition, intercurrent illness may render the mother unfit for pregnancy

Examination of the three maternal age-groups (21 to 30, 31 to 40, 41 to 52) shows that certain recurrent contributory factors slow down the growth rate making the mongoloid infant physiologically immature, and ill-finished" In the highest age-group pregnancy occurred at or near the menopause with a long interval since the last pregnancy this points to involution of the ovary and uterine mucosa Thirteen mothers in this group were mentally sound and of superior type and had given birth to 43 living children In the middle group fertilization was slow (from 5 to 12 years) and after this in 48% of the cases the first child was mongoloid Continued menstruation or threatened abortion during pregnancy was common, with a high incidence of menstrual irregularity before pregnancy, and a history of thyroid disorder The latter was so common in this group that it is suggested that in areas in which thyroid

disorders are prevalent there should be an increase in mongoloid births This suggestion is supported by the findings of Myers (Toronto) In the youngest age-group there was a high percentage of thyroid disorder and slow fertilization time, together with cases in which bleeding during pregnancy or previous abortion had occurred

The conclusion drawn is that genetic factors are not responsible, but that there exists a constellation of factors contributing to a deceleration of developmental rate early in gestation It is suggested that, in order to counter this effect, treatment must start as early as possible *C S Nicholson*

Infant Mortality MARTIN, W J (1949), *Brit med J*, 1, 438

The author, working in the Statistical Research Unit of the Medical Research Council, has reviewed the course of infant mortality in England and Wales during the present century from data tabulated in official statistics

The infant mortality rate was 154 per 1,000 live births in 1900 and 41 in 1947 When the observed rates for the period 1900-47 are plotted as smoothed values on a simple exponential curve the average annual rate of decline is 2 58% From the trend of this curve there is no evidence to support a claim that there has been an exceptional decline in mortality in the past year or two It is suggested that the rate will continue to decline for some years even if no new advances in infant care are made

Since 1911 it has been shown that the decline in mortality rate has been greater in the urban than in the rural districts In that year the mortality rate progressively increased from south to north of the country, and this discrepancy is still evident The decline in rate has been greater among girls than among boys, the annual average rates of decrease being 2 6 and 2 49% respectively

For all causes of death during the first year of life the probability of dying decreases with increasing age Efforts to reduce infant mortality have been more successful in the later periods of the first year of life than in the earlier periods At the present time roughly 40% of all infant deaths occur in the first week of life, this is twice the proportion of 40 years ago The greatest decline in the mortality has been at ages 9-12 months—from one-eighth to one-twentieth of all infant deaths It appears from the decline in mortality in the age period 3 12 months that the curves are becoming asymptotic, so that there is no evidence that there will be much further improvement in the rates at these ages

The seasonal distribution of infant deaths has completely changed In 1900 the highest rate was in the September quarter, but this quarter now has the lowest rate There are no adequate data to explain this, although the diminution in summer diarrhoea is responsible for part of the decline

Analysis of the diseases responsible for the fall is difficult because of the many changes in classification in the past 50 years From a study of the rates for quinquennial periods the following conclusions may be drawn There has been a large improvement in the mortality from measles, whooping-cough, all forms of tuberculosis, bronchitis, and convulsions Mortality from convulsions shows the most spectacular fall—from 14 59 in 1901-05 to 0 83 in 1941-45 The fall in the pneumonia death rate has been small—11 38 in 1901-05 to 8 08 in 1941-45 Mortality from prematurity and from diarrhoea and enteritis has been almost halved in the period, but both are still very important causes of death in 1945 prematurity accounted for 24% of the total infant mortality, diarrhoea and enteritis for 11% Exceptions to the general decline are the rates for congenital malformations and injury at birth Some of the increase in death rate from congenital malformations and from birth injury may be due to the larger proportion of first births The probability of congenital deformity increases with increasing maternal age, so that from the trend of the birth rate a decrease in congenital defects would have to be expected *L M Rose*

A Study of Tuberculosis Mortality in England and Wales STOCKS, P (1949) *Tubercle*, 30, 50

Within the last 75 years in England and Wales tuberculosis mortality has shown a definite trend to reduction it can be said that the percentage reduction in mortality in a unit of time is constantly increasing in spite of the setbacks attributable to wars

Age and sex have an influence on mortality Mortality from respiratory tuberculosis in children under the age of 5 seemed to fall rather rapidly till 1939, since the war, however, it remains on a higher level in the male group and has hardly fallen at all in girls of the same age Among persons between 55 and 75 years old there is very little reduction in mortality since 1939 The cause of this is uncertain, though there is a faint suggestion that better diagnosis has brought into the tuberculosis group the cases which would previously have been treated as "chronic bronchitis"

If the population under study is divided into two groups, one between the ages of 15 and 45 and the second between the ages of 45 and 65, for males and females separately, the regional differences are demonstrated Thus the highest mortality in the younger male group is in the eastern part of South Wales and the county of Durham, and in the older group in Greater London and Cheshire, together with the western part of Lancashire Among females the highest mortality in the younger group is found in the eastern part of Wales and in the northern part of England, and the older female group in the county of Durham and in Wales The significance of morbidity statistics is stressed

Taking into consideration the interrelation of tuberculosis mortality and life expectation, tuberculosis should be considered a most important problem because its eradication would bring the community much more good than that of any other disease *E W Collis*

Tuberculosis Survey of a Suspected School Group ROE, J T N, and DICK, W P (1949) *Tubercle* 30, 39

The finding that among the patients under the care of the Uxbridge Chest Clinic 5 pupils suffering from tuberculosis were at a local technical school led to a fluorographic survey of all the 342 pupils aged 13 to 17 and the staff (33) of the school 327 pupils and 18 of the 19 masters were examined but none of the 8 domestic staff would submit to the examination A tuberculin jelly test was carried out at the time of fluorography As a result of the survey a further 7 cases of pulmonary tuberculosis were found Of these 6 were in scholars aged 15 or over and one was in a master In the two classes in which an open case was found the average proportion of positive reactors was 57% in the 3 classes in which there were only sputum negative cases it was 43%, and in the 2 classes of comparible age group with no

cases of tuberculosis the proportion was 38% The literature on school surveys is reviewed and the 13 cases of tuberculous lesions are described These may be summarized as 4 cases of primary pulmonary tuberculosis, 3 of which were open cases, 4 cases of pleurisy with effusion, and 5 cases of post-primary tuberculosis, one of which was an open case The possibilities of contact infection amongst the boys themselves and also of infection by members of the staff are discussed, but final conclusions cannot be drawn owing to the lack of co-operation on the part of the domestic staff and one master

Among the forms in which an open case of pulmonary tuberculosis was found there were approximately twice the usual number of positive tuberculin reactors for that particular age group The proportion of cases among the 71 positive reactors in the affected forms was equivalent to 155 per 1,000, a distinctly high figure No outside source of infection could be found and only in one case was there any family susceptibility

Although no definite conclusions can be drawn from this survey it is of considerable value in that it indicates that the presence of a case or cases of open tuberculosis in a day school resulted in an incidence of contact infection equal to six times that considered normal for similar age groups The survey also emphasizes the importance of tuberculin testing and mass radiography of scholars within the 13 to 17 age group, and the search for sources of infection where the survey reveals a higher percentage of positive reactors than is considered normal *Frederick Heaf*

Survey of a Scottish Diabetic Clinic. A Study of the Etiology of Diabetes Mellitus MUNRO, H N, EATON, J C, and GLEN, A (1949) *J clin Endocrinol*, 9, 48

This is a statistical study based on the clinical records of 1,309 diabetics seen in the out-patient department and wards of a Glasgow hospital during 1932-42 These are considered to be representative of Scottish diabetics

Diabetes was found to be much more common in middle life. At this stage (after 40), it is more common in women, and particularly so in those with large families, than in a similar group of unmarried women and in men The incidence in the latter two groups is equal Further, up to the age of 40 years, the incidence in men and women is equal, and women out-number men by 2 6 to 1 after this age Of 923 diabetics 23 2% gave a family history of the disease, though only 5 3% of 2,043 non-diabetic people gave such a history A positive family history was less frequently obtained in diabetic women with large families The incidence in women thus appears to be at least partly related to previous childbearing. A history of previous obesity is obtained more frequently in diabetics than in controls, but this could not be correlated with the greater incidence of the disease in married women Hypertension is commoner in diabetic women than in men or a similar group of non-diabetic women This is not related to weight or childbearing Thirteen patients, or 1%, had associated thyrotoxicosis In these the age of onset of the diabetes approximated to the age of onset in non-thyrotoxic diabetic patients rather than to that in non-diabetic thyrotoxic subjects, the incidence of a family history of diabetes in this group corresponded to that in all diabetic cases

It is tentatively suggested that heredity is "fundamental to virtually all cases" and that in such cases obesity, child-bearing, thyrotoxicosis, acromegaly, and sepsis may act "by increasing the susceptibility" *I Grayce*

Incidence of Diabetes Mellitus in Children and Need for Hostels. HENDERSON, P (1949) *Brit med J*, 1, 478

A numerical investigation of the number of diabetic school-children in Britain has been undertaken by the Ministry of Education The result suggests that there are 1,200 such children in England and Wales, of whom 130 require education in an institution because their parents and home conditions make their lives impossible Since 1939 the London County Council has looked after some 60 to 80 such children in Essex, with such good results that they have grown-up into useful adults More hostels for such children are now being established by the Church of England and other voluntary bodies and it appears that adequate provision will soon be available all over the country [No mention is made of the Diabetic Association which really initiated this movement] *R D Lawrence*

Clinical and Social Problems of Epilepsy Parts I and II NATTRASS, F J (1949) *Brit med J*, 1, 1, 43

After reviewing the historical background, the author starts by considering the clinical problems of epilepsy, including the phenomena of local epilepsy, major seizures, petit mal, release phenomena, myoclonus, and status epilepticus He continues with a discussion of diagnosis, in which he considers that there is little to be gained from stressing the questionable relationship between epilepsy and other paroxysmal disorders, such as faints, vaso-vagal attack, laryngeal "epilepsy", narcolepsy, vertigo, and migraine, from which true epilepsy should be firmly differentiated

In dealing with the causes of epilepsy, the author presents an analysis of the age of onset in 991 cases, in 12% of which it was between 31 and 40 years, and in 17% over 40 Comparing these figures with those of earlier series, he claims that, drawn as they are from private practice and the out-patient department of a general hospital, they give a truer picture than those derived from institutions or special hospitals Of 100 patients with epilepsy starting after the age of 40, whom he has followed up for 3 years or more, 25 have died (10 from cerebral tumour, 5 from cerebral vascular disease), but the surviving 75 show no sign of intracranial tumour Moreover, of 200 patients with cerebral tumour, only 28% had fits at any time, and only 19% began with fits, other signs developing within a year in one-half of these In view of these findings, the author believes that in the majority of cases epilepsy —at whatever age it starts—is idiopathic.

He concludes with a review of the social problems of epilepsy, stressing the importance of allaying the excessive fears of parents and urging that epileptic children should stay at school if at all possible, and that infrequent attacks should seldom be held to prevent a young man from adopting the occupation of his choice

[This is an excellent short review of the subject] *N S Alcock*

Sickness Absence due to Peptic Ulcers DOLL, R, and BUCKATSZCH, M M (1949) *Brit J industr Med*, 6, 100

The sickness absence of men with peptic ulcers was determined among 2,871 employees of seven firms six in London and one in a small provincial town, and compared with that of controls of the same age and similarly

employed Of all employees 5 4% had been shown to have a peptic ulcer and their mean sickness absence was 6 working days a year more than that of controls Thus it is calculated that 32 4 working days a year per hundred men are lost as a result of peptic ulcer *C Bruce Perry*

Poliomyelitis and the Social Environment HILL, A B, and MARTIN, W J (1949) *Brit med J*, **2**, 357

It has been suggested that towns with favourable health conditions as revealed by low infant and general mortality rates are peculiarly liable to a heavy incidence of poliomyelitis when that disease becomes epidemic The recorded notifications of poliomyelitis in the 273 large and small towns of England and Wales show no such association between the attack rates they suffered in the 1947 epidemic and the infant and general death rate they experienced in the two preceding years, 1945-46 In other words, according to this experience, favourable mortality rates, indicating social conditions in a locality, need not raise fears of an unduly heavy risk when poliomyelitis becomes widespread —[Authors' summary]

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Brit J soc Med (1949), 4, 157-182

STUDIES ON PUBERTY
PART II THE PATTERN OF DIFFERENTIAL GROWTH*

BY

R H CAWLEY, J A H WATERHOUSE, and HAMILTON HOGBEN

From the Department of Medical Statistics, University of Birmingham

1 INTRODUCTION

Previous investigations concerning growth in the human subject are mainly restricted in scope to consideration of increments in height, in weight, and less often in more specific measurements, related to a chronological time-scale There has been little attempt to interpret such anthropometric material against the background of accredited principles which have been established for other species by the method of experimental embryology

The importance of regional differential growth as the essential feature of the gross morphogenetic, as opposed to histogenetic, aspect of development has been variously emphasized, notably by Child (1915) The study of continuous changes in body proportions from foetus to adult was also brought into focus by D'Arcy Thompson† (1917), who pointed out that the growth intensity of the body conforms with a more or less regular pattern, the relative growth-ratios of parts of the body being defined by an orderly system of growth gradients Anthropometric investigation need not, therefore, be fruitless if directed to evaluating how relative growth of different dimensions during particular phases of development contributes to changes of bodily shape characteristic of the sexes In this way, we may bring into focus problems which await interpretation in terms of our advancing knowledge of cell metabolism

Part I of the present series (Hogben, Waterhouse, and Hogben, 1948) explored certain features of differential growth in relation to qualitative changes taking place at puberty, indicating specific hormonal influences on three sexually-differential indices of body build, viz bispinous width of pelvis, bisacromial width of shoulders, and neck girth It is now our purpose to analyse in greater detail, and from a new viewpoint, such measurable trends of differential growth during the human sexual metamorphosis

Several writers, notably J S Huxley (1924, 1932, 1945), have studied allometric growth (i e disproportionate growth of parts of the body, resulting in change of body-shape with age) more especially with respect to the development of Crustacea and holometabolous insects Huxley's approach to the concept of relative growth envisages the development of the organism as a succession of discrete phases during which growth along one dimension relative to another proceeds with comparative uniformity in accordance with an exponential law, such phases being commonly few in number and long in duration If we consider two such anthropometric measurements as arm length and standing height, the empirical postulate of the allometric attack on morphogenesis is that for any particular period of development arm length (x_a) increases in relation to standing height (x_h) in accordance with an equation of the form

$$x_a = k(x_h)^b \qquad (i)$$

$$\log x_a = b \log x_h + \log k \qquad (ii)$$

By differentiating (ii)

$$\frac{dx_a}{x_a} = b\frac{dx_h}{x_h}$$

and

$$\frac{dx_a}{dx_h}\ \frac{x_h}{x_a} = b \qquad (iii)$$

Now a proportionate *specific growth rate*, for any site or organ, may be defined as the increment in size of that organ, in unit time, per unit size If A represents the size of an organ at one instant, and $A+\delta A$ its size after an interval of time δt, the specific growth ratio (g) would be

$$g = \frac{\delta A}{A}\ \frac{1}{\delta t} = \frac{1}{A}\ \frac{\delta A}{\delta t},$$

And if $a = \log A$,

$$g = \frac{\delta a}{\delta t} \simeq \frac{da}{dt}$$

* Part I appeared in this Journal in January 1948

† This author drew attention to the possibility of studying growth in terms of co-ordinate transformations a suggestion followed up in Medawar s contribution (1944) on measurements of the human foetus From a study of amphibian metamorphosis, one may well suspect that the orderly pattern disclosed by so admittedly attractive s attention from specifically localized foci of erally inviting the evaluation of a specific short the very simplicity of the relations may conceal the complexity of the machinery we are investigating

In

If the relationship between two such logarithmic growth rates is approximately linear, so that

$$a_1 = ba_2 + c\ ,$$

then $$\log A_1 = b \log A_2 + c,$$

and $$A_1 = CA_2^b \text{ where } \log C = c,$$

and the slope is $$b = \frac{da_1}{da_2} = \frac{da_1}{dt} - \frac{da_2}{dt} = \frac{g_1}{g_2}$$

A phase of relative growth is thus definable by the numerical value of the constant b, denoted as the *differential growth coefficient* (or *ratio*) for the two dimensions An important implication of (ii) is that we have eliminated time as a co-ordinate for observation and are subsequently concerned only with *relative growth* of different dimensions The justification for this approach is, of course, entirely empirical, and, as such, calls for validification in any particular investigation such as the present Our reasons for thus experimentally adopting the method are (*a*) that it is reasonable to suppose that growth follows an exponential law, which is best illustrated by using logarithms of measurements, (*b*) that with such use of logarithms the allometric equation reduces to that of a straight line, a form which, if permissible, facilitates interpretation of results This approach appears to be a good empirical approximation herein, as may be judged from the graphs included below

In examining the relevance of the method to a study of human sex differentiation, we require a more exacting analytical technique Huxley's development of the theme, competent within the domain of invertebrate growth and form as first used, involves a legitimate crudity in that it relies on intuition to arbitrate on the choice of a standard axis of reference, i e the abscissa, defined by Huxley merely as a measure of growth of the body in general as opposed to growth of a specific part, represented by the ordinate There is no *a priori* reason why the growth rates in the two sexes of height, weight, or any other particular measurement should tally, so we must first make a direct investigation of sex differentials at different sites in order to establish which, if any, exhibit *sexually invariant* growth rates during puberty

The present investigation was conducted on records of a single examination of each individual in a sample comprising 642 boys and 662 girls drawn from a sequence of half-yearly age groups from 8½ to 17 years This plan allows direct observation and yields age-means of metric indices as well as the time of first appearance and duration of development of non-metric features of sexual maturation The sample was taken from primary and secondary schools in the borough of Tottenham Data were recorded during routine school medical examinations and comprised, in addition to the qualitative attributes of sexual development recorded and discussed in the preceding publication, the following dimensions

1 Weight
2 Height
3 Sitting height
4 Trunk length (suprasternal notch to pubic symphysis)
5 Trunk depth (nipple level)
6 Trunk width (nipple line)
7 Thorax circumference (*a*) at nipple, (*b*) at xiphoid process
8 Abdominal circumference (umbilicus)
9 Bisacromial width of shoulders
10 Bispinous width of pelvis* (posterior superior iliac spines)
11 Girth of neck (level of thyroid cartilage)
12 Arm length (acromion to 1st carpal crease)
13 Hand length (1st carpal crease to tip of 3rd finger)
14 Leg length (anterior superior iliac spine to external malleolus)
15 Cephalic length
16 Cephalic breadth
17 Bizygomatic width

For our present purpose we are concerned only with average measurements representative of selected somatic features as above, for each age group The range of variability to which the individual is subject is a separate problem, reserved for further communication Here we restrict ourselves to an overall picture of a *composite* individual, himself or herself a fiction, legitimate as a summary of a more or less homogeneous sample

2 Sexual Homoplasia and Heteroplasia

In searching for a sexually invariant or *homoplasic* dimension (i e one characterized by the same proportionate growth rate for both sexes throughout the age-range studied) in contradistinction to the state of *heteroplasia*, our procedure has been to plot on a logarithmic grid successive mean values of a particular dimension A for girls as ordinates against the corresponding mean values for boys of the same half-year group We have then found it possible to give close representation of the distribution by fitting one or more straight lines, the parameters of which define the trend of relative growth during the relevant phase of development If A_f and A_m

* We take this opportunity of drawing attention to an ambiguity in the title of two text figures of Part I (January 1948) in which the expression *pelvic* width might suggest bicristal as opposed to bispinous width.

respectively specify a measurement for girls and boys of the same age group,

then $$\log A_f = l \log A_m + c, \quad (i)$$

i e $$A_f = C(A_m)^l$$

and $$\frac{dA_f}{A_f} = l \frac{dA_m}{A_m} \quad (ii)$$

l and C respectively denote the *sexually differential growth coefficient* and the *sexually differential growth constant*

Typically, the graphs were sigmoidal, showing a three-phase inter-relationship, but occasionally there were two linear trends or only one The usual method of curve-fitting for a series of points having a linear trend is by the determination of one of two regression coefficients by the method of least squares This method assumes dependence of one variate upon the other by minimizing either the abscissal or the ordinate differences, and is therefore unsuitable in situations such as the present in which we are seeking the relationship between two variates which are logically independent, although concurrent We have therefore used for curve-fitting throughout this study a technique of *least square-perpendiculars*, giving the line of closest fit to all the points A detailed account of the rationale of this method and of appropriate measures of goodness-of-fit will be the subject of a subsequent communication

Fig 1 (overleaf) shows the sigmoidal three-phase growth relationship typical of most dimensions, and the deviations from this plan characteristic of atypical dimensions Table I (overleaf) demonstrates the relevant parameters for each dimension for each discrete phase of growth, and for the whole eight years, together with the goodness-of-fit criteria The ratio of the residual variance of the points about the fitted line to their variance about a line at right angles may be expressed as $(1-R^2)$ where R is an analogue of the product-moment correlation coefficient, $R^2=1$ signifying a perfect fit A second criterion of reliability shows the justification for fitting two or three separate lines to the distribution Σp^2, the residual variance of the points representative of a particular growth-epoch about the line which exclusively summarizes that epoch, is expressed as a ratio to the residual variance, ΣP^2, of the same points about a line specifying growth over the whole period In our use of these two ratios as goodness-of-fit criteria, they are best expressed as percentages, i e $100(1-R^2)$ and $100\frac{\Sigma p^2}{\Sigma P^2}$ The product-moment correlation coefficient, also tabulated, is a general summarizing index of concurrence between the two sexes, but has no exact significance here

By recourse to this procedure, we can define the typical pattern of growth in females relative to males in chronological terms, since each point on the charts refers to a particular age At an age varying from 10 75 to 11 75, the female-male growth ratio in most dimensions undergoes a striking change in favour of the female, and 2 to $2\frac{1}{2}$ years later there is a second equally abrupt change in the opposite direction From these observations *per se*, it would be illegitimate to draw conclusions respecting the sex-specificity of either change Comparison with our previously published observations on parallel changes taking place in the same sample, however, brings to light a striking analogy At 11 25 years half the girls in the sample are exhibiting the first qualitative signalization of puberty, the development of the mammary glands It is not until two years later, at 13 25, that half the boys in the sample show the first signs of the earliest male characteristic, pubic hair In view of the closeness of the distribution to symmetry, there will be little difference between the median age and the mean age of appearance of the sexual metamorphosis We have in fact strong grounds for associating the inception of visible qualitative manifestations of a new phase of endocrine activity in girls at 11 25 years and in boys at 13 25 years, with the discontinuities in the relative growth rates of boys and girls at most sites at an age from 10 75 to 11 75 and again between 13 25 and 14 25 years, confirming the suspected existence of a growth spurt at the beginning of puberty

Such a pattern of growth, characteristic of females relative to males, holds good for weight, height, sitting height, trunk length, thorax circumference (at nipple and at xiphoid process), abdominal circumference, arm length (with and without hand), leg length, trunk depth, and neck girth Certain other dimensions do not conform to this plan Trunk width (Fig 1d) and bisacromial width (Fig 1f) can be resolved into two lines only, stimulation of growth rate appears to be confined to the male Bispinous width discloses an arresting picture (Fig 1g) indicative of striking sexual heteroplasia the female pelvis evidently grows more rapidly after the onset of puberty and the male pelvis more slowly, since the slope increases at the time of onset of puberty in each sex A difference not emphasized in Part I of this series is that cephalic length (Fig 1h) stops increasing in the pubescent female, whilst cephalic breadth (Fig 1i) exhibits no stimulation at puberty in either sex A third cephalic measurement taken, bizygomatic width, apparently undergoes more random variation than any other feature studied

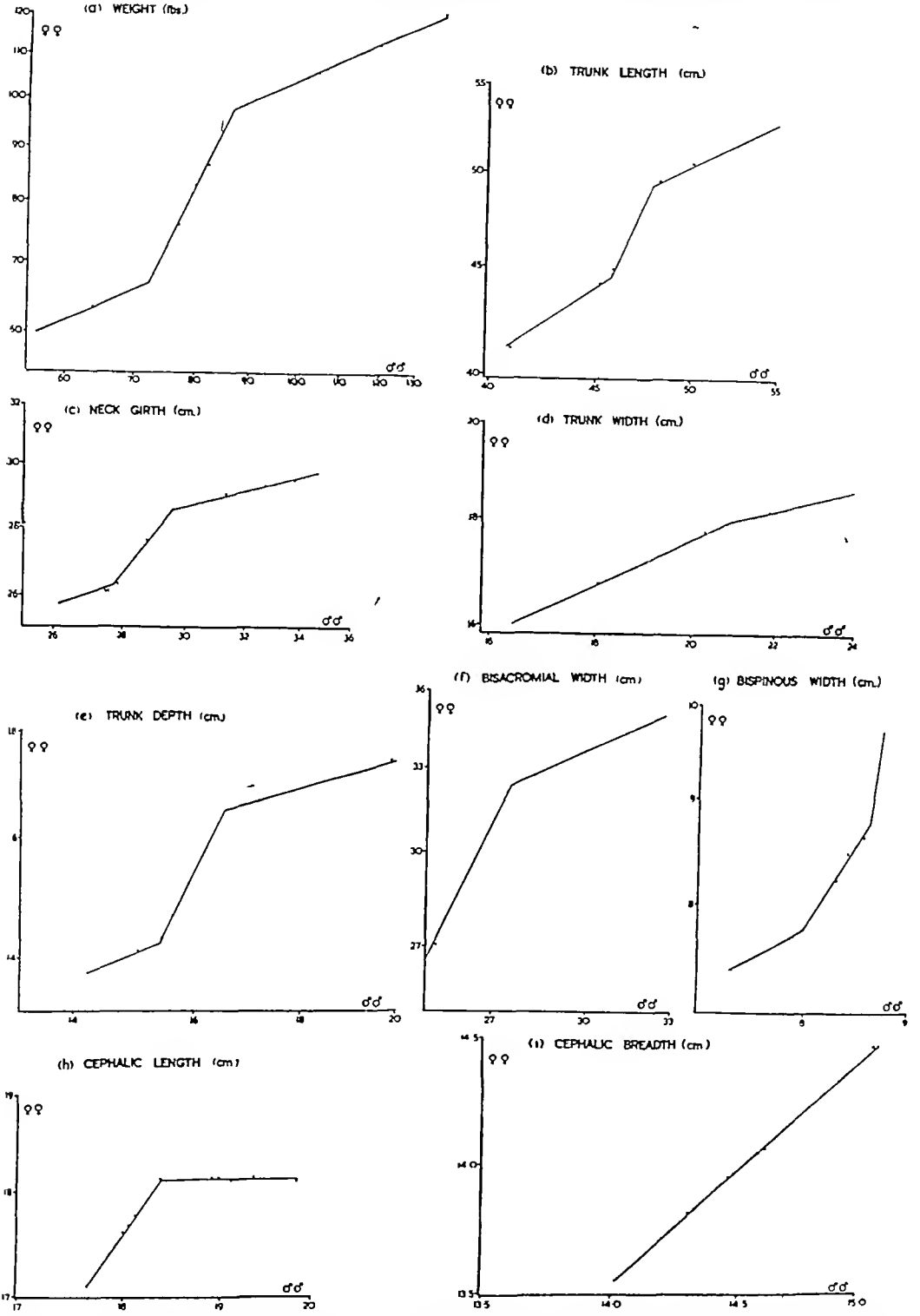

FIG 1 —Growth of girls relative to boys illustrated by logarithmic plotting of corresponding age-means

TABLE I

PHASES OF SEXUALLY DIFFERENTIAL GROWTH

Dimension	Age (years)	r	l	C	$100\,(1-R_l^2)$	$100(\Sigma p^2-\Sigma P^2)_l$
Weight	8 75–16 75	0 964	0 9149	1 489	1 93	
	8 75–10 75	0 864	0 4499	9 743	4 37	17 09
	10 75–13 25	0 972	2 2624	0 0041	2 65	4 48
	13 25–16 75	0 927	0 4801	11 41	2 39	22 45
Height	8 75–16 75	0 980	0 7418	3 615	0 87	
	8 75–11 25	0 950	0 6707	5 069	2 09	41 28
	11 25–13 25	0 958	1 5123	0 0794	2 28	8 34
	13 25–16 75	0 964	0 4340	17 38	1 08	15 46
Sitting height	8 75–16 75	0 950	0 8656	1 791	2 50	
	8 75–11 25	0 889	0 8006	3 070	2 45	45 95
	11 25–13 25	0 927	2 0147	0 0026	3 02	8 11
	13 25–16 75	0 833	0 4424	11 70	5 16	39 51
Trunk length	8 75–16 75	0 966	0 9817	1 074	1 71	
	8 75–11 25	0 801	0 6837	3 262	9 85	6 15
	11 25–13 25	0 925	2 1799	0 0107	2 33	14 99
	13 25–16 75	0 941	0 5108	6 834	2 18	19 00
Thorax circumference (nipple)	8 75–16 75	0 963	1 1623	0 4921	1 75	
	8 75–11 75	0 954	0 9774	1 059	2 44	39 11
	11 75–13 75	0 948	2 4063	0 0025	1 22	6 01
	13 75–16 75	0 817	0 5242	8 130	6 71	36 40
Thorax circumference (xiphoid)	8 75–16 75	0 938	0 8720	1 651	3 23	
	8 75–11 75	0 883	1 1753	0 4641	6 24	63 53
	11 75–13 75	0 814	2 1647	0 0072	6 60	20 76
	13 75	0 706	0 2678	22 57	5 95	23 20
Abdominal circumference	8 75–16 75	0 943	0 8975	1 496	3 16	
	8 75–10 75	0 865	0 2846	17 06	0 96	8 87
	10 75–13 25	0 920	2 3562	0 0041	2 47	10 44
	13 25–16 75	0 822	0 3594	14 08	4 74	26 18
Total arm length	8 75–16 75	0 970	0 7593	2 589	1 88	
	8 75–10 75	0 935	0 6254	4 439	2 69	56 75
	10 75–13 25	0 863	1 4100	0 0172	8 58	38 81
	13 25–16 75	0 891	0 3866	12 94	3 03	27 55
Arm length	8 75–16 75	0 960	0 7771	2 187	1 96	
	8 75–10 75	0 950	0 5270	5 577	1 51	74 00
	10 75–13 25	0 772	1 7398	0 0525	10 21	39 42
	13 25–16 75	0 921	0 3294	13 25	1 82	9 79
Hand length	8 75–16 75	0 945	0 7195	2 240	2 35	
	8 75–10 75	0 804	0 9125	1 297	10 78	37 82
	10 75–13 25	0 979	1 3711	0 3642	1 10	3 71
	13 25–16 75	0 933	0 2891	7 949	0 41	7 94
Leg length	8 75–16 75	0 959	0 7030	3 667	1 72	
	8 75–10 75	0 939	0 7782	2 625	2 71	34 77
	10 75–13 25	0 906	1 2346	0 3712	4 72	27 89
	13 25–16 75	0 911	0 2674	25 84	2 81	9 91
Trunk depth	8 75–16 75	0 934	0 8716	1 348	3 39	
	8 75–11 25	0 853	0 4523	4 137	4 85	19 43
	11 25–13 75	0 896	2 5255	0 0140	2 57	8 10
	13 75–16 75	0 646	0 3357	6 401	10 21	43 76
Neck girth	8 75–16 75	0 944	0 5913	3 735	2 36	
	8 75–11 75	0 720	0 3541	8 110	7 57	37 52
	11 75–13 75	0 880	1 5747	0 1390	5 36	13 08
	13 75–16 75	0 842	0 2671	11 54	3 06	24 88
Bispinous width	8 75–16 75	0 911	1 6558	0 2587	3 80	
	8 75–11 75	0 730	0 5368	2 548	6 12	34 11
	11 75–14 25	0 799	1 9569	0 1338	0 38	46 58
	14 25–16 75	0 201	6 7384	$4\ 6(10^{-5})$	26 94	70 73
Trunk width	8 75–16 75	0 931	0 3997	5 303	1 49	
	8 75–13 25	0 823	0 5101	3 824	6 68	89 63
	13 25–16 75	0 750	0 2716	7 852	5 02	78 69
Bisacromial width	8 75–16 75	0 923	1 0660	0 8960	4 08	
	8 75–13 25	0 939	2 0857	0 0321	1 73	18 03
	13 25–16 75	0 875	0 4831	6 510	4 05	25 75
Cephalic breadth	8 75–16 75	0 789	0 4896	4 407	8 19	
	8 75–13 25	0 844	1 3962	0 3095	7 71	10 91
	13 25–16 75	−0 0576	−0 0080	17 71	10 95	0 89
Bizygomatic width	8 75–16 75	0 865	0 9260	1 174	7 26	—

r = product moment correlation coefficient.

l = sexually differential growth coefficient.

$(1-R_l^2)$ and $(\Sigma p^2-\Sigma P^2)_l$ = goodness-of fit criteria.

C = sexually differential growth constant.

We must now compare directly the pre- and post-pubescent growth patterns in the two sexes By what is mathematically equivalent to a change of origin, we can make comparisons between the dimensions of boys and girls at corresponding developmental or *pubertal* ages, the latter being here defined as *age with respect to the onset of puberty* (Table II) In accordance with conclusions set forth in Part I of this series, and confirmed by the present method, our average estimates for qualitative and quantitative signalization of puberty —our so-called *critical* ages—are 11 25 and 13 25 years for girls and boys respectively We therefore plot for each dimension the mean for girls aged x years as ordinates against the corresponding mean for boys aged $(x+2)$ years, and obtain a result comparatively undistorted by differential age at onset of pubertal acceleration

TABLE II

CHRONOLOGICAL RELATIONSHIPS OF PUBERTAL AGE

Group No	Pubertal Age (years)	Chronological Age (years)	
		Boys	Girls
1	−2 5	10 75	8 75
2	−2 0	11 25	9 25
3	−1 5	11 75	9 75
4	−1 0	12 25	10 25
5	−0 5	12 75	10 75
6	0	13 25	11 25
7	+0 5	13 75	11 75
8	+1 0	14 25	12 25
9	+1 5	14 75	12 75
10	+2 0	15 25	13 25
11	+2 5	15 75	13 75
12	+3 0	16 25	14 25
13	+3 5	16 75	14 75

Fig 2 (opposite) shows the results of the application of this correction For we can write

$$\log A_f = v \log A_{m+2} + k$$

$$A_f = K(A_{m+2})^v$$

and

$$\frac{dA_f}{A_f} = v \frac{dA_{m+2}}{A_{m+2}} \qquad \text{(iii)}$$

v and K respectively denote the *standardized sexually differential growth coefficient* and the *standardized sexually differential growth constant*, and are exhibited for each phase of relative growth in Table III (overleaf) In this series there is no discernible discontinuity in the trend of the growth rate of girls relative to boys with respect to weight, height, sitting height, trunk length, trunk width, thorax circumference (at nipple and at xiphoid process), abdominal circumference, arm length, and leg length Trunk depth and neck girth display a relative increase of female growth, at approximately eighteen months and six months respectively after the estimated age of inception of puberty Bisacromial width and cephalic length and breadth (Figs 1f, h, and i) undergo a relative spurt in boys, and bispinous width (Fig 1g) exhibits a striking change in the opposite direction at the same time The scatter for each phase of growth is shown as before both graphically and by the goodness-of-fit criteria

We now have two estimates of the course of relative growth in males and females based respectively on chronological and pubertal age Our intention is not to impute conformity of growth with a particular mathematical formulation, but to group and summarize the data conveniently Accordingly, our necessary conditions for sexual homoplasia may be defined as

(1) (*a*) Exhibition of the characteristic sigmoidal or triphasic pattern of relative growth when mean observations paired on a chronological basis are plotted on a logarithmic scale

(*b*) Equivalence of the net growth rate in the two sexes with reference to the whole age-range

i e $\frac{dA_f}{A_f} = \frac{dA_m}{A_m}$, and $l=1$ (cf equation (ii))

(2) (*a*) Exhibition of a continuous rectilinear relationship when boy-girl means are paired on a development age scale centred at the start of puberty in each sex

(*b*) For the whole range of this relationship,

$$\frac{dA_f}{A_f} = \frac{dA_{m+2}}{A_{m+2}}, \text{ i e } v=1 \text{ (cf equation (iii))}$$

(3) Satisfaction of the goodness of-fit criteria,

$$R^2 \text{ and } \frac{\Sigma p^2}{\Sigma P^2}$$

Since conditions (1) *b* and (2) *b* are the salient numerical desiderata of conformity between male and female growth-patterns, it is desirable to rank all dimensions satisfying (1) *a* and (2) *a* with respect to each of these For arranging dimensions in order of equivalence of male and female growth rates, computation of $(l-1)$ and $(v-1)$ immediately suggests itself We can therefore write

$$l-1 = \left(\frac{dA_f}{A_f} - \frac{dA_m}{A_m}\right) - 1$$

$$= \frac{\frac{dA_f}{A_f} - \frac{dA_m}{A_m}}{\frac{dA_m}{A_m}} \qquad \text{(iv)}$$

$$= \frac{\text{Excess growth rate of females over males}}{\text{Male growth rate}}$$

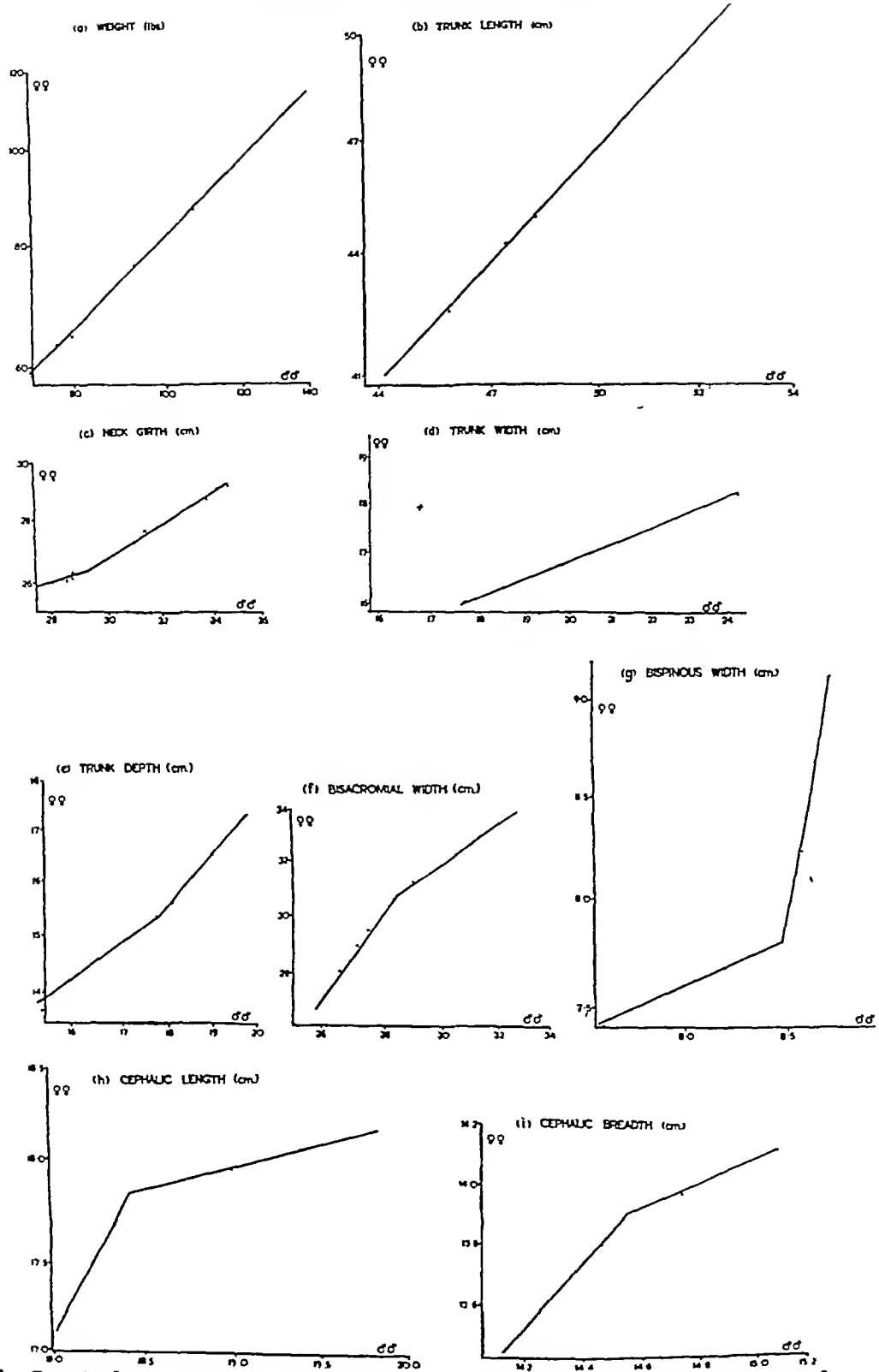

FIG 2.—Growth of girls relative to boys of the same pubertal age illustrated by logarithmic plotting of age-means for corresponding pubertal ages

TABLE III

PHASES OF SEXUALLY DIFFERENTIAL GROWTH
(DEVELOPMENTAL BASIS)

Dimension	Pubertal Age (years)	r	v	K	$100\,(1-R_v^2)$	$100\,(\Sigma p^2-\Sigma P^2)_1$
Weight	(−2 5)–(+3 5)	0 988	0 9883	0 8630	0 43	—
Height	(−2 5)–(+3 5)	0 981	0 8627	1 858	0 89	—
Sitting height	(−2 5)–(+3 5)	0 976	0 8216	2 064	0 93	—
Trunk length	(−2 5)–(+3 5)	0 983	1 0825	0 6776	1 27	—
Thorax circumf (nipple)	(−2 5)–(+3 5)	0 982	1 1931	0 3972	0 69	—
Thorax circumf (xiphoid)	(−2 5)–(+3 5)	0 935	0 9236	1 260	3 37	—
Abdominal circumference	(−2 5)–(+3 5)	0 988	1 0260	0 8347	0 80	—
Total arm length	(−2 5)–(+3 5)	0 961	0 9053	1 305	0 55	—
Arm length	(−2 5)–(+3 5)	0 957	0 9910	0 8774	2 18	—
Hand length	(−2 5)–(+3 5)	0 969	0 7951	1 718	1 53	—
Leg length	(−2 5)–(+3 5)	0 972	0 8767	1 604	1 52	—
Trunk depth	(−2 5)–(+3 5)	0 984	0 8702	1 274	0 83	—
	(−2 5)–(+1 5)	0 956	0 7272	1 895	2 03	73 11
	(+1 5)–(+3 5)	*0 983*	*1 1355*	*0 5855*	*1 16*	*32 78*
Neck girth	(−2 5)–(+3 5)	0 964	0 5467	4 192	1 59	—
	(−2 5)–(+0 5)	0 583	0 3274	8 736	12 77	81 41
	(+0 5)–(+3 5)	0 925	0 6383	3 043	0 94	20 09
Bispinous width	(−2 5)–(+3 5)	0 818	1 7435	0 2050	7 91	—
	(−2 5)–(+0 5)	0 724	0 5132	2 611	11 74	22 18
	(+0 5)–(+3 5)	0 495	5 0763	1 5(10⁻⁴)	9 47	43 23
Trunk width	(−2 5)–(+3 5)	0 950	0 3934	5 178	*1 85*	—
Bisacromial width	(−2 5)–(+3 5)	0 964	1 0212	0 9813	1 83	—
	(−2 5)–(+0 5)	0 917	1 6212	0 1361	3 85	42 84
	(+0 5)–(+3 5)	0 921	0 7325	2 636	2 87	56 59
Cephalic length	(−2 5)–(+3 5)	0 796	0 5390	3 664	0 62	—
	(−2 5)–(+0 5)	0 593	1 7874	0 0975	20 92	47 92
	(+0 5)–(+3 5)	0 417	0 2473	8 668	17 76	77 37
Cephalic breadth	(−2 5)–(+3 5)	0 882	0 7738	1 742	6 07	—
	(−2 5)–(+1 0)	0 678	1 1577	0 6267	19 03	85 54
	(+1 0)–(+3 5)	0 957	0 4415	4 263	1 72	19 30

r=product moment correlation coefficient.
v=sexually differential standardized growth coefficient
K=sexually differential standardized growth constant
$(1-R_v^2)$ and $(\Sigma p^2-\Sigma P^2)_v$=goodness-of fit criteria.

A more satisfactory index would be

$$\frac{\text{Excess growth rate of females over males}}{\text{Mean growth rate of males and females}}$$

$$=2\left\{\frac{\frac{dA_f}{Af}-\frac{dA_m}{A_m}}{\frac{dA_f}{A_f}+\frac{dA_m}{A_m}}\right\}$$

$$=2\left\{\frac{\left(\frac{dA_f}{A_f}-\frac{dA_m}{A_m}\right)-1}{\left(\frac{dA_f}{A_f}-\frac{dA_m}{A_m}\right)+1}\right\}$$

$$=2\,\frac{l-1}{l+1} \qquad \text{(v)}$$

Furthermore, if θ is the angular deviation from $\frac{\pi}{4}$ (i e from $l=1$) of any particular growth trend,

$$l=\tan\left(\frac{\pi}{4}+\theta\right)=\frac{1+\tan\theta}{1-\tan\theta},$$

$$l-1=\frac{1+\tan\theta-(1-\tan\theta)}{1-\tan\theta}=\frac{2\tan\theta}{1-\tan\theta},$$

and $$l+1=\frac{1+\tan\theta+(1-\tan\theta)}{1-\tan\theta}=\frac{2}{1-\tan\theta}$$

Then $$\frac{l-1}{l+1}=\left(\frac{2\tan\theta}{1-\tan\theta}\right)\Big/\left(\frac{2}{1-\tan\theta}\right)=\tan\theta \qquad \text{(vi)}$$

For true growth, θ will have a maximum range from $-\frac{\pi}{4}$ through 0 to $+\frac{\pi}{4}$, and $\tan\theta$ will have a range from -1 to $+1$ Such a range is ideal for our purpose, and we have defined *indices of sexual heteroplasia*, denoted by μ, having a range from -1 to $+1$, as

(1) With reference to a chronological basis,

$$\mu_l=\tan\theta_l=\frac{l-1}{l+1} \qquad \text{(vii)}$$

and *mutatis mutandis*,

(2) With reference to a developmental background,

$$\mu_r=\tan\theta_r=\frac{r-1}{r+1} \qquad \text{(viii)}$$

μ_l and μ_r represent in terms of relative growth

$$1\quad \frac{\text{Excess growth rate of female over male}}{\text{Mean growth rate}}$$

$$2$$

Tables IV and V exhibit the values of the indices, in order of increasing heteroplasia over the whole age-range for the dimensions satisfying the stipulations (1) *a* and (2) *a* above

As regards satisfaction of condition (3) above, a refinement which could be practised at this stage is the standardization of the indices according to their consistency in conforming to a particular trend, i e by weighting with the appropriate values of R^2 Since the latter is consistently near to 1, this procedure makes no difference to the rank order of the dimensions with regard to heteroplasia (Table VI, overleaf) The dimensions do not differ significantly in their proximity to strictly linear concomitant variation of boys and girls

TABLE IV

INDEX OF SEXUAL HETEROPLASIA OVER WHOLE AGE-RANGE FOR SELECTED DIMENSIONS (CHRONOLOGICAL BASIS)

Rank	Dimension	l	μ_l
1	Trunk length	0 9817	−0 0092
2	Weight	0 9149	−0 0444
3	Abdomen	0 8975	−0 0540
4	Thorax (xiphoid)	0 8720	−0 0684
5	Sitting height	0 8656	−0 0720
6	Thorax (nipple)	1 1623	+0 0751
7	Arm length	0 7771	−0 1254
8	Total arm length	0 7593	−0 1368
9	Height	0 7418	−0 1482
10	Hand length	0 7195	−0 1631
11	Leg length	0 7030	−0 1744

l = sexually differential growth coefficient
μ_l = index of sexual heteroplasia

Returning to Tables IV and V, we notice firstly that there is a high preponderance of negative indices indicative of heteroplasia in favour of the male, and secondly that there is a considerable difference in the order of heteroplasia on the chronological and developmental assessments On *a priori* grounds it would be expected that the different methods should give two estimates of the same concept, since much of the net effect of the pubertal acceleration will be common to both sexes, and only the residual

TABLE V

INDEX OF SEXUAL HETEROPLASIA FOR SELECTED DIMENSIONS (DEVELOPMENTAL BASIS)

Rank	Dimension	r	μ_r
1	Arm length	0 9910	−0 0045
2	Weight	0 9883	−0 0059
3	Abdomen	1 0260	+0 0128
4	Trunk length	1 0825	+0 0396
5	Thorax (xiphoid)	0 9236	−0 0397
6	Total arm length	0 9053	−0 0497
7	Leg length	0 8767	−0 0657
8	Height	0 8627	−0 0737
9	Thorax (nipple)	1 1931	−0 0880
10	Sitting height	0 8216	−0 0979
11	Hand length	0 7951	−0 1141

r = standardized sexually differential growth coefficient
μ_r = index of sexual heteroplasia.

TABLE VI

INDICES OF HETEROPLASIA

STANDARDIZED WITH REFERENCE TO LINEAR CONCOMITANCE

Dimension	Chronological Assessment		Developmental Assessment	
	Rank	$\mu_l - R_l^2$	Rank	$\mu_v - R_v^2$
Trunk length	1	−0 0094	4	+0 0401
Weight	2	−0 0453	2	−0 0059
Abdomen	3	−0 0558	3	+0 0129
Thorax (xiphoid)	4	−0 0707	5	−0 0411
Sitting height	5	−0 0738	10	−0 0988
Thorax (nipple)	6	+0 0764	9	+0 0886
Arm length	7	−0 1279	1	−0 0046
Total arm length	8	−0 1394	6	−0 0500
Height	9	−0 1495	8	−0 0744
Hand length	10	−0 1670	11	−0 1159
Leg length	11	−0 1775	7	−0 0667

μ=Indices of sexual heteroplasia.
R^2=criteria of linearity

variation will show itself in the values of μ_l, and only by virtue of the fact that the pubertal acceleration is approximately equivalent in the two sexes do we satisfy our condition (i e linear relationship) with respect to v and μ_v In spite of the slightly different connotations of l and v consequent upon the exclusion of the younger male and older female age groups in the computation of v, it is legitimate to regard both as representative of the course of relative growth, standardized with regard to differential time of onset of sexual maturation If we regard μ_l and μ_v merely as different estimates, we are justified *in combining them by finding their* arithmetic mean If, on the other hand, we regard the two sets of indices as not directly comparable but mutually dependent on a common causal system, we can effect a compromise in the order of the dimensions by taking the mean of their rank scores These two procedures are demonstrated in Table VII

From Tables IV to VII we can now make out a short-list, characterized by close proximity to zero, of indices obtained by both appraisals of relative growth between the sexes, weight, trunk length, abdominal circumference, and lower thorax circumference will comprise this short-list Of these, *weight is rejected since it is a cubic measure (see* below) and of restricted value for comparison with

TABLE VII

INDICES OF HETEROPLASIA

MEANS AND MEAN RANK SCORES FOR CHRONOLOGICAL AND DEVELOPMENTAL ASSESSMENTS

Dimension	A. $\frac{1}{2}(\mu_l+\mu_v)$		B Mean Rank Score	
	Rank	Value	Rank	Value
Trunk length	1	−0 0152	2	2 5
Abdomen	2	−0 0206	3	3 0
Weight	3	−0 0252	1	2 0
Thorax (xiphoid)	4	−0 0541	5	4 5
Arm length	5	−0 0650	4	4 0
Thorax (nipple)	6	+0 0816	7=	7 5
Sitting height	7	−0 0850	7=	7 5
Total arm length	8	−0 0933	6	7 0
Height	9	−0 1110	9	8 5
Leg length	10	−0 1201	10	9 0
Hand length	11	−0 1386	11	10 5

μ_l=index of sexual heteroplasia (chronological basis)

μ_v=index of sexual heteroplasia (developmental basis)

our other dimensions We must hesitate in giving precedence to circumferential measurements as indicators of the basic growth-potential of the body, since biological considerations lead us to suppose that a number of distinct growth-gradients will be involved Consequently trunk length is adopted as our standard of reference for estimation of regional differential growth rates

Additional support for this choice may be obtained from study of both parameters of the allometric equation for trunk length

$$T_f = 1\ 074(T_m)^{0\ 9817}$$

The differential growth constant, as well as the coefficient, is very close to unity, i e there is with respect to trunk length a close similarity between the sexes, not only of growth but also of absolute size

3 Specific Growth Coefficients

Having selected trunk length on empirical grounds as our sexually invariant dimension, we now proceed to plot, separately for each sex, mean values of any other dimension A for each age group as ordinates on a double logarithmic grid against the corresponding mean trunk length Our exploratory graphs fall into two categories according to whether there is evidence of one or two distinguishable linear trends That the fitted lines are justified as summarizing trends of relative growth during the age periods they represent we may judge by the goodness-of-fit criteria tabulated below

We may express each phase of growth along a dimension A relative to trunk length (T) as follows

(*a*) For males

$$\log A_m = b \log T_m + h \qquad \text{(i)}$$

$$A_m = HT_m^b \qquad \text{(ii)}$$

Differentiating (i)

$$\frac{dA_m}{dT_m} = b\,\frac{A_m}{T_m} \qquad \text{(iii)}$$

or

$$\frac{dA_m}{A_m} = b\,\frac{dT_m}{T_m} \qquad \text{(iv)}$$

(*b*) *Mutatis mutandis* for females

$$\log A_f = g \log T_f + j \qquad \text{(v)}$$

$$A_f = JT_f^g, \qquad \text{(vi)}$$

and

$$\frac{dA_f}{dT_f} = g\,\frac{A_f}{T_f} \qquad \text{(vii)}$$

or

$$\frac{dA_f}{A_f} = g\,\frac{dT_f}{T_f} \qquad \text{(viii)}$$

We refer to the parameters b and g, representing growth-partition between the trunk and dimension A, as the specific growth coefficients (S G C s) of the dimension A for boys and girls respectively H and J are the specific growth constants We have, therefore, a convenient method of comparing growth-rates specific for certain dimensions of the body in terms of (*a*) proportionate size of the dimension, equations (iii) and (vii), (*b*) growth rate along trunk length, equations (iv) and (viii)

We employ Huxley's nomenclature to designate change of relative proportions with increase of absolute size as *allometry* The use of "heterogony" in this sense has been rejected because of ambiguous or alternative meanings (Huxley and Reeve, 1945) Accordingly, we can define dimensions of the body which are growing faster or slower than trunk length respectively as positively or negatively allometric, the appropriate S G C s having values greater or less than unity For the special category where b (or g) is equal to unity we speak of *isometry* The existence of *monophasic* or *diphasic* growth patterns for each dimension underlines the theme of Huxley's thesis that specific growth coefficients are normally constant for long periods of the life-history, and from time to time undergo abrupt changes One dimension (cephalic breadth) appears to be *triphasic* with respect to the female

The trends of specific growth for all our dimensions are shown by Figs 3 and 4* (overleaf) and Table VIII (p 170) For each phase of growth, defined in terms of pubertal age (see Table II), Table VIII exhibits the S G C and growth constant of each dimension in the two sexes, together with the proportionate residual variance, 100 $(1-R^2)$, and the product-moment correlation coefficient

Growth equations *per se* are a fiction and have value only to summarize the average course of growth over a period, but in seeking an understanding of the underlying *Entwicklungsmechanik* at particular stages of the life-history, we can discuss the several levels of allometry estimated for our dimensions during particular phases of growth taking trunk length as our base-line, i e as the definitive isometric axis †

The specific growth coefficient is a *multiplicative index*, i e a ratio of growth rates, and in this form is meaningful, but comparisons referable to allometry of opposite sign introduce a disparity of range, viz. 0 to 1 in the domain of negative allometry and 1 to ∞ in the positive A derived function of

* For the sake of clarity in comparison of male and female growth the individual points (paired measurements) have been omitted from these graphs

† This approach shows up the inadequacy of previous allometric analysis. It is meaningless to speak of allometry unless we state with reference to what dimension the relationship hold That we need the same basis for comparison is now self-evident the standard is necessarily arbitrary but should be uniform for the group compared

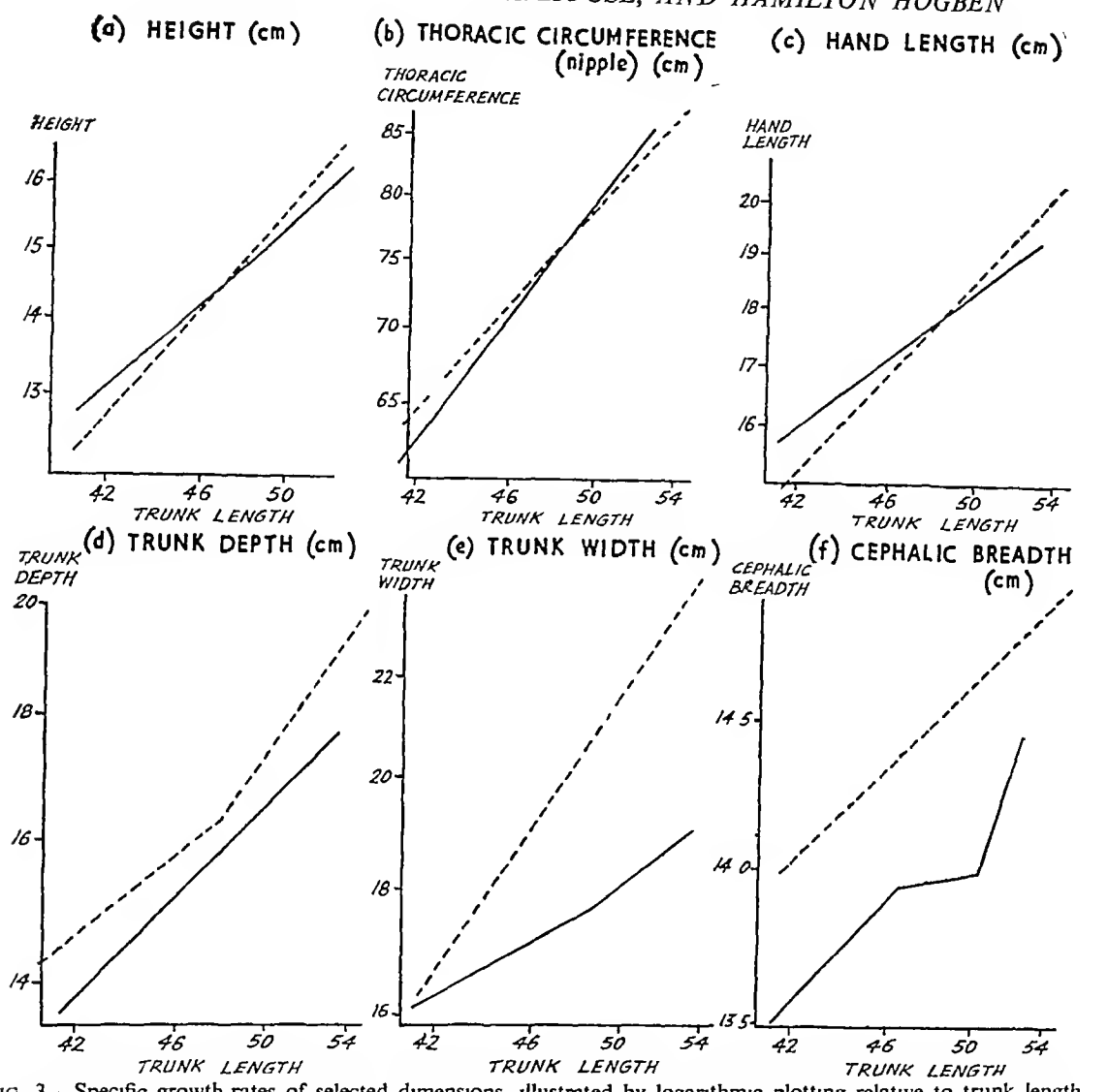

FIG 3 —Specific growth-rates of selected dimensions, illustrated by logarithmic plotting relative to trunk length (*a*), (*b*), and (*c*) monophasic growth in both sexes, (*d*) monophasic in females, diphasic in males, (*e*) diphasic in females, monophasic in males, (*f*) triphasic in females, monophasic in males

Broken line males Full line females

the S G C with a discrete range, ideally of ± 1 about zero, is preferable Accordingly, we use whichever form of the ratio between the growth coefficients is a fraction of unity thus if b or $g < 1$ we consider the S G C $\left(=\frac{dA}{A}-\frac{dT}{T}\right)$ itself, or if b or $g > 1$, we use the reciprocal of the S G C $\left(=\frac{dT}{T}-\frac{dA}{A}\right)$

Thus we define an *index of allometry* (ρ) as follows

(*a*) if $0 < (\text{S G C}) \leqslant 1$,

$$\rho_b = b - 1 \text{ and } \rho_g = g - 1$$

(*b*) if $1 \leqslant (\text{S G C})$,

$$\rho_b = 1 - \frac{1}{b} \text{ and } \rho_g = 1 - \frac{1}{g}$$

Admittedly, we can provide no *prima facie* justification for this index, but we may judge its usefulness by comparison of two hypothetical dimensions A and B having S G C s of $\frac{1}{3}$ and 3

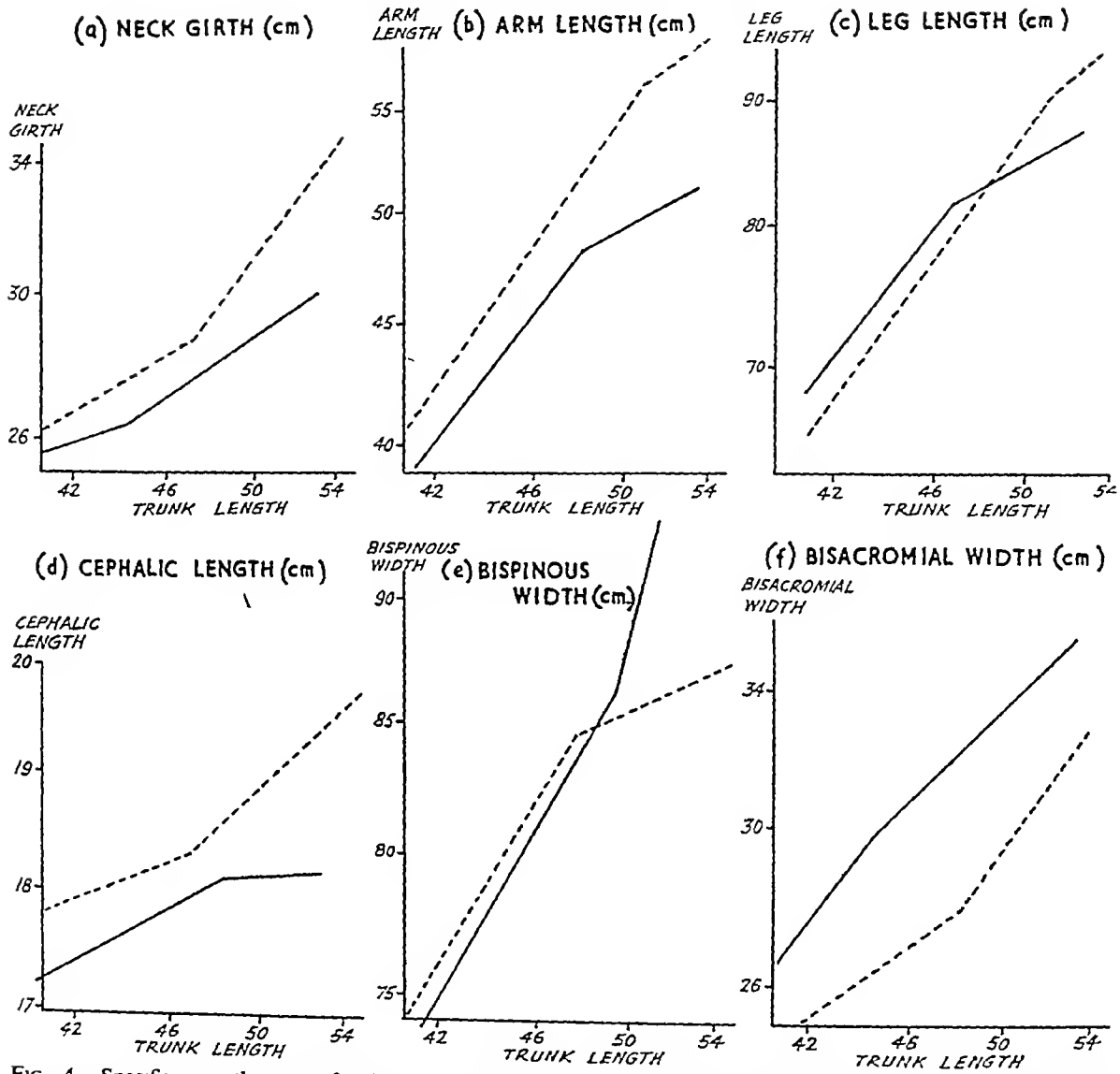

FIG 4.—Specific growth-rates of selected dimensions, illustrated by logarithmic plotting relative to trunk length (*a*), (*b*), and (*c*) sexually concordant diphasic growth, (*d*), (*e*), and (*f*) sexually discordant diphasic growth

Broken line males Full line females

respectively Trunk length is then increasing itself at three times the rate of *A*, and *B* is growing three times as fast as trunk length The equal allometry is shown by the ρ derivatives

$$\text{for } A,\ \rho = (S\,G\,C - 1) = -\frac{2}{3}$$

$$\text{for } B,\ \rho = 1 - \frac{1}{(S\,G\,C)} = 1 - \frac{1}{3} = +\frac{2}{3}$$

The figures set out in Table IX (p 171) appear to justify the restricted use of this device, which preserves the ordinal rank of the S G C s though their absolute magnitudes are not directly comparable, and of course facilitates the comparison of positive and negative coefficients

4 The Relativity of Allometric Growth

At this stage it is pertinent to comment on dangers inherent in conclusions from growth gradients referable to indiscriminately chosen bodily dimensions As before we can write for each

TABLE VIII

PHASES OF SPECIFIC GROWTH

Dimension	Boys					Girls				
	Pubertal Age (years)	b	H	$100(1-R_b^2)$	r	Pubertal Age (years)	g	J	$100(1-R_g^2)$	r
Weight	(−4 5)-(+3 5)	3 3240	2 34(10^{-1})	6 47	0 990	(−2 5)-(+5 5)	3 0928	5 78(10^{-4})	4 43	0 995
Height	(−4 5)-(+3 5)	1 1936	1 487	0 71	0 990	(−2 5)-(+5 5)	0 9251	4 185	1 10	0 992
Sitting height	(−4 5)-(+3 5)	0 9687	1 858	1 11	0 983	(−2 5)-(+5 5)	0 8595	2 836	0 55	0 994
Thorax circumference (nipple)	(−4 5)-(+3 5)	1 1537	0 8586	0 42	0 991	(−2 5)-(+5 5)	1 3599	0 3857	0 45	0 990
Thorax circumference (xiphoid)	(−4 5)-(+3 5)	1 0081	1 421	0 37	0 980	(−2 5)-(+5 5)	0 9011	2 070	0 88	0 986
Abdominal circumference	(−4 5)-(+3-5)	1 0033	1 237	0 62	0 988	(−2 5)-(+5 5)	0 9239	1 619	1 43	0 992
Total arm length	(−4 5)-(+1 0)	1 4188	0 2849	0 78	0 992	(−2 5)-(+1 5)	1 2477	0 5273	2 45	0 949
	(+1 0)-(+3 5)	0 8507	2 660	1 57	0 969	(+1 5)-(+5 5)	0 8106	2 327	4 83	0 903
Arm length	(−4 5)-(+1 0)	1 4748	0 1705	0 12	0 994	(−2 5)-(+1 5)	1 4298	0 1907	4 01	0 913
	(+1 0)-(+3 5)	0 7853	2 564	1 47	0 964	(+1 5)-(+5 5)	0 5691	5 314	4 57	0 891
Hand length	(−4 5)-(+3 5)	1 1007	0 2620	0 89	0 986	(−2 5)-(+5 5)	0 7925	0 8672	7 51	0 854
Leg length	(−4 5)-(+1 0)	1 4478	0 3011	0 84	0 981	(−2 5)-(+1 5)	1 4099	0 3607	1 90	0 962
	(+1 0)-(+3 5)	0 8686	2 950	0 99	0 973	(+1 5)-(+5 5)	0 6261	7 319	23 66	0 910
Trunk depth						(−2 5)-(+5 5)	1 0447	0 2781	1 49	0 986
	(−4 5)-(+0 5)	0 8005	0 7365	1 06	0 910					
	(+0 5)-(+3 5)	1 3660	0 0842	3 87	0 918					
Neck girth	(−4 5)-0	0 6328	2 508	0 00	0 990	(−2 5)-(+0 5)	0 3385	7 319	4 76	0 809
	0-(+3 5)	1 3646	0 1491	1 79	0 969	(+0 5)-(+5 5)	0 7216	1 707	1 00	0 976
Trunk width	(−4 5)-(+3 5)	1 4930	0 0627	0 57	0 988					
						(−2 5)-(+1 5)	0 5475	2 104	6 37	0 862
						(+1 5)-(+5 5)	0 7558	0 9374	15 62	0 795
Bisacromial width	(−4 5)-(+1 0)	0 7175	1 726	2 92	0 939	(−2 5)-(+1 5)	1 3483	0 1772	1 87	0 960
	(+1 0)-(+3 5)	1 3498	0 1486	3 43	0 865	(+1 5)-(+5 5)	1 0604	0 5228	4 10	0 922
Bispinous width	(−4 5)-(+0 5)	0 8403	0 3287	9 13	0 828	(−2 5)-(+2 0)	0 8918	0 2663	1 09	0 971
	(+0 5)-(+3 5)	0 2221	3 583	56 13	0 354	(+2 0)-(+5 5)	1 7571	0 0091	1 87	0 953
Cephalic length	(−4 5)-0	0 1951	8 628	2 09	0 811	(−2 5)-(+2 0)	0 2696	6 349	1 33	0 908
	0-(+3 5)	0 5828	1 923	4 37	0 869	(+2 0)-(+5 5)	0 245	16 44	0 55	0 176
Cephalic breadth	(−4 5)-(+3 5)	0 2523	5 446	2 87	0 802					
						(−2 5)-(+1 0)	0 2714	4 911	2 15	0 825
						(+1 0)-(+3 0)	0 0584	11 13	0 39	0 682
						(+3 0)-(+5 5)	0 6421	1 128	8 52	0 818

b = specific growth coefficient (S G C.) (males)
H = specific growth constant (males)
g = specific growth coefficient (females)
J = specific growth constant (females)
$(1\ R^2)$ = goodness-of fit criterion.
r = product moment correlation coefficient.

TABLE IX

INDICES OF ALLOMETRY (ρ_b AND ρ_g) FOR SEPARATE PHASES OF SPECIFIC GROWTH

Dimension	Boys		Girls	
	Pubertal Age (years)	ρ_b	Pubertal Age (years)	ρ_g
Weight	(−4 5)–(3 5)	0 6991	(−2 5)–(+5 5)	0 6774
Height	(−4 5)–(+3 5)	0 1625	(−2 5)–(+5 5)	−0 0749
Sitting height	(−4 5)–(+3 5)	−0 0313	(−2 5)–(+5 5)	−0 1405
Thorax circumf (nipple)	(−4 5)–(+3 5)	0 1334	(−2 5)–(+5 5)	0 2647
Thorax circumf (xiphoid)	(−4 5)–(+3 5)	0 0076	(−2 5)–(+5 5)	−0 0989
Abdominal circumference	(−4 5)–(+3 5)	0 0028	(−2 5)–(+5 5)	−0 0761
Total arm length	(−4 5)–(+1 0) (+1 0)–(+3 5)	0 2951 −0 1493	(−2 5)–(+1 5) (+1 5)–(+5 5)	0 1987 −0 1894
Arm length	(−4 5)–(+1 0) (+1 0)–(+3 5)	0 3221 −0 2147	(−2 5)–(+1 5) (+1 5)–(+5 5)	0 3007 −0 4309
Hand length	(−4 5)–(+3 5)	0 0916	(−2 5)–(+5 5)	−0 2075
Leg length	(−4 5)–(+1 0) (+1 0)–(+3 5)	0 3095 −0 1314	(−2 5)–(+1 5) (+1 5)–(+5 5)	0 2908 −0 3739
Trunk depth	(−4 5)–(+0 5) (+0 5)–(+3 5)	−0 1995 0 2679	(−2 5)–(+5 5)	−0 0428
Neck girth	(−4 5)–0 0 –(3 5)	−0 3672 0 2672	(−2 5)–(+0 5) (+0 5)–(+5 5)	−0 6615 −0 2784
Trunk width	(−4 5)–(+3 5)	0 3303	(−2 5)–(+1 5) (+1 5)–(+5 5)	−0 4525 −0 2442
Bisacromial width	(−4 5)–(+1 0) (+1 0)–(+3 5)	−0 2825 0 2592	(−2 5)–(+1 5) (+1 5)–(+5 5)	0 2582 0 0568
Bispinous width	(−4 5)–(+0 5) (+0 5)–(+3 5)	−0 1597 −0 7779	(−2 5)–(+2 0) (+2 0)–(+5 5)	−0 1082 0 4307
Cephalic length	(−4 5)–0 0 –(+3 5)	−0 8049 −0 4172	(−2 5)–(+2 0) (+2 0)–(+5 5)	−0 7304 −0 9755
Cephalic breadth	(−4 5)–(+3 5)	−0 7477	(−2 5)–(+1 0) (+1 0)–(+3 0) (+3 0)–(+5 5)	−0 7286 −0 9416 −0 3579

phase of growth of a dimension A (ordinate) relative to a second dimension B (abscissa),

either $$A_m = H_{AB} B_m^{b_{AB}} \quad (i)$$

or $$A_f = J_{AB} B_f^{g_{AB}} \quad (ii)$$

Thus $$\frac{dA_m}{A_m} = b_{AB} \frac{dB_m}{B_m} \quad (iii)$$

and $$\frac{dA_f}{A_f} = g_{AB} \frac{dB_f}{B_f} \quad (iv)$$

We here designate parameters b_{AB} and g_{AB} being linear gradients referable to the course of relative (i e logarithmic) growth of boys and girls respectively, as the *relative growth ratio* between dimensions A and B for males and females We

TABLE X

RELATIVE GROWTH RATIOS AND CONSTANTS FOR SELECTED PAIRS OF DIMENSIONS

Dimensions $A \times B$	Boys					Girls				
	Pubertal Age	b_{AB}	H_{AB}	$100(1-R^2)$	r	Pubertal Age	g_{AB}	J_{AB}	$100(1-R^2)$	r
Bisacromial width × Neck girth	(−4 5)-(+3 5)	0 9606	1 078	1 54	0 986	(−2 5)-(+0 5)	5 8482	1 48(10⁻⁷)	4 50	0 597
						(+0 5)-(+5 5)	1 2544	0 4921	2 14	0 958
Bispinous width × Neck girth	(−4 5)-(+0 5)	1 2490	0 1237	8 61	0 836	(−2 5)-(+2 5)	1 5141	0 0549	0 68	0 984
	(+0 5)-(+3 5)	0 2004	4 283	8 82	0 512	(+2 5)-(+5 5)	2 4395	0 0024	1 89	0 926
Cephalic length × Neck girth	(−4 5)-(+3 5)	0 3504	5 653	2 04	0 981	(−2 5)-(+2 0)	0 4880	3 552	4 59	0 869
						(+2 0)-(+5 5)	0 0218	16 82	1 73	0 131
Weight × Height	(−4 5)-(+3 5)	2 7787	0 00107	2 41	0 994	(−4 5)-(+3 5)	3 3499	0 0001	5 23	0 992

b_{AB}=relative growth ratio between dimensions A and B g_{AB}=relative growth ratio $100(1-R^2)$=goodness-of fit criterion.
H_{AB}=relative growth constant J_{AB}=relative growth constant. r=product moment coefficient of correlation.

use H_{AB} and J_{AB} as corresponding *relative growth constants* Relevant data for such selected comparisons appear in Table X, in which values of $100\ (1-R^2)$ justify the use of linear summarizing trends Fig 5 (opposite) shows the course of growth along three diphasic dimensions relative to neck girth, which also exhibits a diphasic pattern of growth Wherever we plot two diphasic dimensions *inter se*, we observe, with reference to the discontinuities, the effect of either *reinforcement* (growth-rates change in opposite directions) or *cancellation* (both increasing or decreasing) The latter may be complete or partial

On the threshold of puberty in the male, neck girth, bisacromial width, and cephalic length alike enter upon a phase of more intensive growth, while growth of the bispinous dimension decreases Neck girth and bispinous width of the female, in contrast to bisacromial width and cephalic length, undergo a spurt Interpretation of Fig 5 in the light of these is simple against the background of information we derive from choice of an appropriate sexually invariant dimension It is true that we could justifiably make comparison of growth along any dimensions we choose by always using the same abscissa, e g relative to neck girth in Fig 5a, b, and c, but this would be of limited utility because of the fallibility of comparisons between growth rates of corresponding dimensions in alternate sexes For instance, we should be tempted to conclude that a dimension A having the same growth-rate with respect to the neck in both sexes was sexually invariant, we should be unable to come to any decision on this question if we were ignorant as to whether in fact increase of neck girth was itself sexually invariant—a condition for the conclusion stated

The weight-height relationship is often cited as a parameter descriptive of bodily *habitus*, and the expression $W \propto H^3$ is held to be definitive of this relationship Table X includes the parameters of the growth equation together with the estimates of conformity to a linear trend The estimated relative growth ratio of weight to height, 2 78 for males and 3 35 for females, is evidently a sexually differential characteristic In this connexion a confirmatory technique suggests itself If we designate the S G C s of dimensions A and B for boys as b_A and b_B respectively,

$$\text{then} \qquad \frac{dA_m}{A_m} = b_A \quad \frac{dT_m}{T_m},$$

$$\text{and} \qquad \frac{dB_m}{B_m} = b_B \quad \frac{dT_m}{T_m},$$

so that, other things being equal,

$$\frac{dA_m}{A_m} = \frac{b_A}{b_B} \quad \frac{dB_m}{B_m}$$

$$\frac{b_A}{b_B} = b_{AB} \qquad (v)$$

The qualification is necessary since the argument assumes that the residual variation about the linear trends for A and B is negligible and that there is no special conformity or retro-action between A and B which would not show in estimations of growth rates relative to trunk length We shall obtain

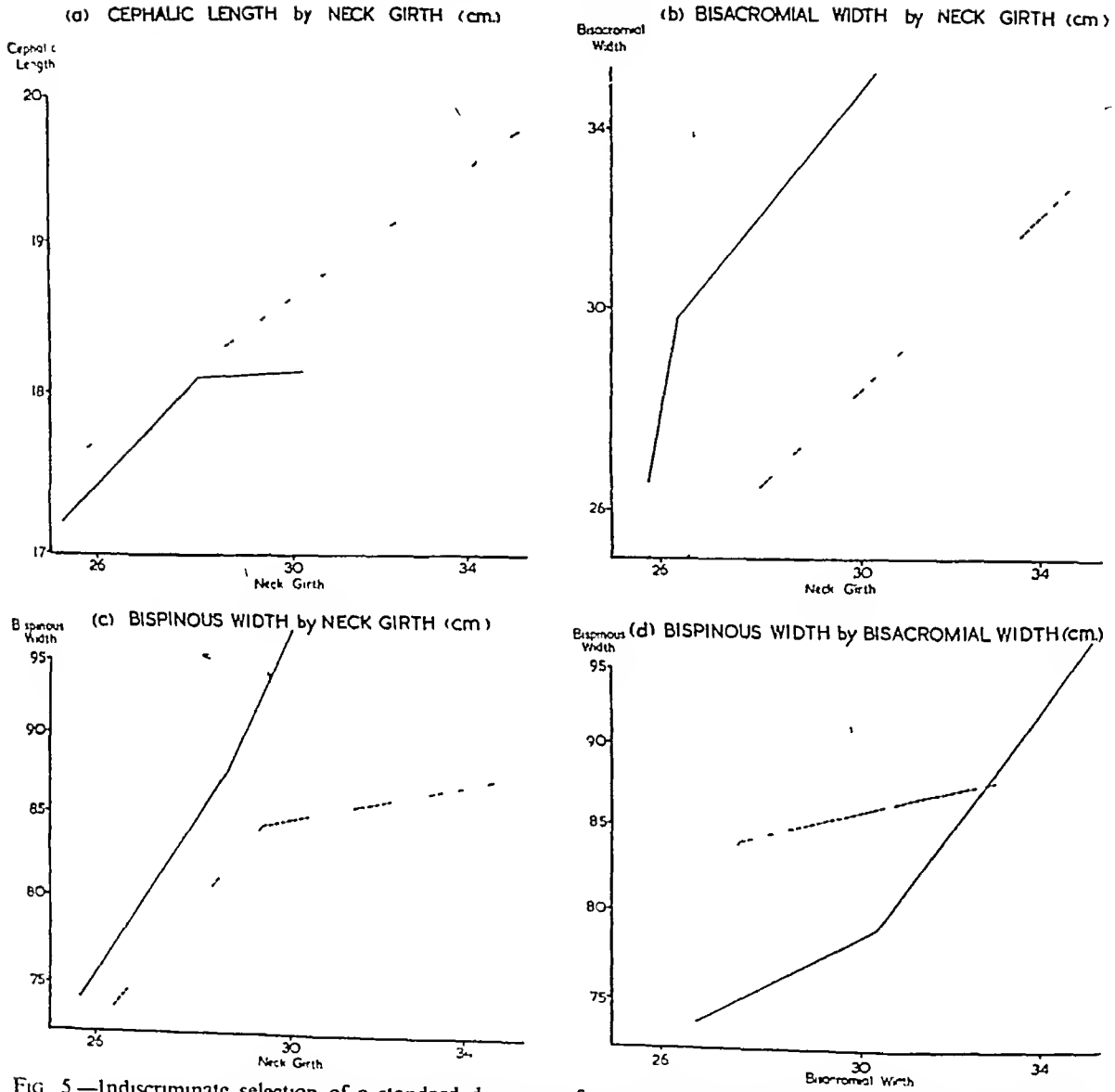

FIG 5.—Indiscriminate selection of a standard dimension for comparing growth rates in the two sexes (*a*)-(*c*), showing use of neck girth as a yardstick give pictures which are *prima facie* misleading (cf Fig 4) (*c*) and (*d*) contrast patterns of growth of bispinous width relative to different standards

Broken line males Full line females

approximate agreement with the formal postulate of equation (1) where there is close correlation of growth processes of the dimensions A and B and trunk length, and more divergence where the summarizing trends of which b_A, b_B and b_{AB} are parameters are less exact although each may be valid in its own right The S G C s for height and weight and the ratio of these with the relative growth ratio for these dimensions *inter se* have been tabulated (Table XI, overleaf), and it will be seen that there is a strikingly close agreement, which enhances the validity of the method we are exploiting

Application of the same procedure to other pairs of dimensions shows that the approximations and assumptions in the confirmatory technique are not always justified (Table XI) Furthermore the age-delimitations of the discrete phases of growth do not always conform for the two regions in question,

TABLE XI

COMPARISON OF RATIO OF S G C s WITH RELATIVE GROWTH RATIO

$A \times B$	Sex	Phase	$(S\,G\,C)_A$	$(S\,G\,C)_B$	$\frac{(S\,G\,C)_A}{(S\,G\,C)_B}$	Relative Growth Ratio
Weight × Height	M	(monophasic)	3 3240	1 1936	2 7849	2 7787
	F	(monophasic)	3 0928	0 9251	3 3432	3 3499
Neck girth × Weight	M	1	0 6328	3 3240	0 1904	0 2352
		2	1 3646		0 4107	0 3432
	F	1	0 3385	3 0928	0 1094	0 1000
		2	0 7216		0 2333	0 2351
Bispinous width × Neck girth	M	1	0 8403	0 6328	1 3279	1 2490
		2	0 2221	1 3646	0 1628	0 2004
	F	1	0 8918	0 3385	2 6346	1 5141
		2	1 7571	0 7216	2 4350	2 4395
Cephalic length × Bispinous width	M	1	0 1951	0 8403	0 2321	0 1678
		2	0 5828	0 2221	2 6240	1 4357
	F	1	0 2696	0 8918	0 3024	0 2903
		2	0 0245	1 7571	0 0066	0 0023

so that in effect we may be comparing the ratio of the S G C of dimension A over a period of x years to that of B over y years with the relative growth ratio of A to B over z years

An alternative confirmatory technique is a corollary to equation (v) If the S G C s for a dimension A, for the whole age-period, for boys and girls respectively are b_A and g_A,

so that $$\frac{dA_m}{dT_m} = b_A$$

and $$\frac{dA_f}{dT_f} = g_A$$

whence $$\frac{g_A}{b_A} = \frac{dA_f}{dA_m} \frac{dT_m}{dT_f},$$

TABLE XII

COMPARISON OF RATIO OF S G C s WITH SEXUALLY DIFFERENTIAL GROWTH COEFFICIENT

Dimension A	S G C			$\frac{g_A}{b_A} l_T$	l_A
	b_A	g_A	$\frac{g_A}{b_A}$		
Weight	3 3240	3 0928	0 9304	0 9134	0 9149
Height	1 1936	0 9251	0 7751	0 7609	0 7418
Sitting height	0 9687	0 8595	0 8873	0 8711	0 8656
Thorax (xiphoid)	1 0081	0 9011	0 8939	0 8775	0 8720
Thorax (nipple)	1 1537	1 3599	1 1787	1 1571	1 1623
Abdominal circumference	1 0033	0 9239	0 9209	0 9040	0 8975
Hand length	1 1007	0 7925	0 7200	0 7068	0 7195

b_A = S G C (male) of dimension A

g_A = S G C (female) of dimension A

l_A = sexually differential growth coefficient of dimension A

l_T = sexually differential growth coefficient of trunk length ($\equiv 1$)

and if the slope of the *mean* trend of growth of girls relative to boys along A again for the complete age-range studied, is l_A (see Table I)

so that $$\frac{dA_f}{dA_m} = l_A,$$

then $$l_A = \frac{g_A}{b_A}\ \frac{dT_f}{dT_m},$$

i e $$l_A = \frac{b_A}{g_A}\ l_T\ , \qquad \text{(vi)}$$

and as $l_T = 1$ according to our assumptions,

$$l_A = \frac{g_A}{b_A} \qquad \text{(vii)}$$

Since S G C s and sexually differential growth coefficients are estimates, we introduce a new source of error by computing the ratio of two such indices Nevertheless, the procedure reinforces our confidence in the use of the allometric equation Table XII exhibits the sexually differential growth coefficients, and analogous approximations derived from specific growth coefficients, for dimensions showing a constant S G C throughout our age-group There is very close agreement between $\frac{g_A}{b_A}$ l_T and l_A When we give l_T its theoretical value (=1), the correspondence between $\frac{g_A}{b_A}$ and l_A is also good Such correspondence justifies this type of analysis and vindicates the choice of trunk length as a basis for comparison

5 Sex Differentials in Size and Shape

The term *sexual heteroplasia* has already been introduced to denote differential growth rates between the sexes, and *sexual dimorphism* here signifies, in its literal sense, differential size and shape The two concepts are, of course, interdependent, sexual dimorphism is a direct result of heteroplasia, but the same organ may at different stages in the life cycle be (*a*) sexually isomorphic and heteroplasic, (*b*) sexually dimorphic and homoplasic The condition for dimorphism is a state of heteroplasia over some period of the life history, but successive phases of positive and negative heteroplasia, or *vice versa*, in the same dimension may result in isomorphism

Differential and specific growth coefficients are in fact growth ratios standardized with respect to the differential size of the dimensions compared, and offer no direct indication of the latter We can obtain an estimate of relative size from the genera formula $A_f = CA_m^l$, viz $\frac{A_f}{A_m} = CA_m^{l-1}$, but it is simpler and in addition useful as a confirmatory device to compute such directly from the data We can investigate sexual dimorphism between boys and girls of the same chronological age, and thus observe

TABLE XIII
Index of Sexual Dimorphism
(Chronological Basis)

	Dimension	*s* for Age (years)			
		8 75	11 25	13 25	16 75
1	Weight	0 0217	−0 0164	0 0615	−0 0586
2	Height	0 0167	−0 0045	0 0168	−0 0238
3	Sitting height	0 0015	−0 0045	0 0021	−0 0250
4	Trunk length	0 0011	−0 0117	0 0152	−0 0061
5	Abdominal circumference	0 0159	−0 0147	0 0020	−0 0171
6	Thorax circumference (nipple)	−0 0106	−0 0153	0 0238	−0 0087
7	Trunk depth	−0 0215	−0 0439	−0 0009	−0 0890
8	Neck girth	−0 0133	−0 0282	−0 0130	−0 0732
9	Arm length	−0 0105	−0 0415	−0 0212	−0 0637
10	Total arm length	−0 0032	−0 0256	−0 0090	−0 0549
11	Cephalic length	−0 0147	−0 0170	−0 0050	−0 0462
12	Leg length	0 0224	0 0033	0 0207	−0 0309
13	Trunk width	−0 0068	−0 0205	−0 0464	−0 1130
14	Thorax circumference (xiphoid)	−0 0272	−0 0136	0 0045	−0 0425
15	Bisacromial width	0 0195	0 0490	0 0737	0 0382
16	Bispinous width	−0 0020	−0 0038	−0 0077	0 0454
17	Hand length	0 0111	0 0178	0 0250	−0 2977
18	Cephalic breadth	−0 0231	−0 0151	−0 0131	−0 0210
19	Bizygomatic width	0 0176	0 0245	0 0276	0 0227

N B —Positive values indicate larger size of female

changes in its nature and extent *pari passu* with constant or changing phases of heteroplasia To do this we have constructed an *index of sexual dimorphism* (s) analogous to the *indices of heteroplasia* (see equations (vi) to (viii)) For a dimension A, with the usual notation,

$$s = \frac{1}{2} \frac{\text{Excess size of female dimensions over male}}{\text{Mean size of dimension in the two sexes}}$$

i e

$$s = \frac{A_f - A_m}{A_f + A_m}$$

It is not possible to construct an index which has a convenient range and also retains a precise significance in terms of relative size The index s has in practice a limited range, and a value of zero signifies isomorphism So defined, *positive* dimorphism signifies larger size of the female in the relevant dimension, *negative* dimorphism the reverse

We have seen that we may distinguish three phases of differential growth in the age range studied (i) both sexes are prepubescent, (ii) girls only have entered upon puberty, (iii) the process has already started in both sexes Table XIII exhibits values of s for the youngest chronological age-group in the sample, for the estimated ages of onset of each succeeding new phase of relative growth, and for the upper age limit of our records Examination of this table reveals what we might expect

(*a*) The index s is lower at the beginning of puberty in females than at the start of the age range, i e girls are in general smaller relative to boys at 11 25 years than at 8 75 Indeed, at the time of onset of puberty in girls, their size is absolutely smaller than boys of the same age along all dimensions studied except shoulder width, hand length, and leg length

(*b*) When girls have been pubescent for two years and boys are on the verge of the process, they are bigger than boys along most dimensions, and where still absolutely smaller, are less so than they were two years previously, the only exception being referable to trunk width

(*c*) For our oldest age group there is again a preponderance of negative indices, boys are bigger than girls at this age along all dimensions except bisacromial and bispinous widths

Computation of the proportionate size of pairs of dimensions at particular ages (Table XIV, opposite) gives an immediate clue to the somatic outline characteristic of each sex Trunk length contributed slightly more to total stature in boys than in girls in the youngest age group and less in the oldest age group This is *en rapport* with (*a*) a smaller proportionate contribution of leg length in young boys than in girls of the same age group, (*b*) the reversal of the situation for the older ages, (*c*) what our figures disclose concerning growth of legs relative to trunk In short, there is greater emphasis on trunk in the contour of the prepubescent boy and on legs in that of the prepubescent girl During the course of puberty, the picture changes Boys become proportionately longer in the leg than girls Arms of boys are throughout proportionately longer than those of girls, and the female arm is appreciably shorter in relation to the leg than is that of the male Trunk width becomes proportionately larger in boys and smaller in girls, and trunk depth is consistently greater in boys Bisacromial width becomes proportionately greater in girls and less in boys, but there are indications which point to a reversal of these trends subsequent to the age of our oldest group Bispinous width of boys becomes smaller in relation to trunk length while that of girls remains fairly constant

6 Morphogenetic Patterns of Sexual Maturation

If we attribute the inception of a new phase of growth at puberty to a specific stimulus incident to the sexual metamorphosis, we can conveniently subsume our dimensions within the following fourfold taxonomy

Type 1 Growth monophasic in both sexes
Type 2 Growth monophasic in males, diphasic (or triphasic) in females
Type 3 Growth monophasic in females, diphasic in males
Type 4 A Sexually concordant diphasic growth
B Sexually discordant diphasic growth

Our main findings for each dimension studied, thus classified, appear in Table XV (overleaf) In almost every case, our criteria of reliability vindicate what the figures convey Against this background we are in a position to present a more coherent picture of sexually differentiated growth To avoid periphrasis, it is necessary to emphasize that all statements which follow refer to group averages in contradistinction to individuals

Trunk —The depth of the trunk does not greatly alter proportionally in either sex Younger boys (age 8 75) are isomorphic with girls in length, and are both thicker and broader (at all levels measured) With increasing age, length remains uniform, boys continue to be thicker than girls and become increasingly broader Trunk width forms an increasingly greater proportion of thorax circumference at the nipple in boys (Table XIV), a fact which is responsible for the unexpectedly high rate of increase of the latter dimension in boys and its

TABLE XIV

PROPORTIONATE SIZE OF SELECTED DIMENSIONS

Dimensions	Boys				Girls			
	Ratio for Age (years)				Ratio for Age (years)			
	8 75	11 25	13 25	16 75	8 75	11 25	13 25	16 75
Sitting height / Height	0 5531	0 5269	0 5246	0 5218	0 5363	0 5269	0 5290	0 5205
Trunk length / Height	0 3279	0 3214	0 3223	0 3131	0 3178	0 3168	0 3213	0 3244
Leg length / Height	0 5246	0 5361	0 5409	0 5518	0 5306	0 5445	0 5452	0 5448
Leg length / Trunk length	1 6000	1 6680	1 6781	1 7622	1 6695	1 7189	1 6970	1 6770
Total arm length / Trunk length	1 3576	1 3959	1 4153	1 4736	1 3458	1 3578	1 3487	1 3366
Hand length / Total arm length	0 2742	0 2575	0 2559	0 2530	0 2846	0 2808	0 2739	0 2662
Leg length / Total arm length	1 1786	1 1949	1 1857	1 1958	1 2405	1 2660	1 2582	1 2547
Trunk width / Trunk length	0 3990	0 3915	0 4092	0 4553	0 3928	0 3847	0 3618	0·3673
Trunk depth / Trunk length	0 3483	0 3475	0 3396	0 3718	0 3329	0 3259	0 3288	0 3304
Trunk width / Thorax circumf (nipple)	0 2586	0 2701	0 2685	0 2803	0 2606	0 2556	0 2333	0 2273
Bisacromial width / Trunk length	0 6263	0 5902	0 5803	0 6097	0 6498	0 6664	0 6525	0 6662
Bispinous width / Trunk length	0 1802	0 1748	0 1763	0 1652	0 1806	0 1776	0 1737	0 1832
Bispinous width / Bisacromial width	0 2878	0 2963	0 3039	0 2710	0 2779	0 2666	0 2662	0 2750

isomorphism in spite of the effect of inclusion of the female breasts Trunk width also progressively increases in boys in relation to trunk length, and decreases in girls Trunk depth is greater in proportion to length in boys and tends to become increasingly so Vertically and horizontally in the dorsoventral plane, there is a sharp spurt of growth at the beginning of puberty in either sex, but trunk width appears to respond to a specifically male stimulus

TABLE XV

BALANCE-SHEET OF PUBESCENT GROWTH

Dimension	Sexual Heteroplasia				Sexual Dimorphism		Allometry					
	Phase						Female			Male		
	Prepubescent	♀ pubescent ♂ prepubescent	Pubescent	8 75–16 75 years	8 75 years	16 75 years	Phase 1	Phase 2	Pubertal age at inception of new phase	Phase 1	Phase 2	Pubertal age at inception of new phase
Trunk length	–	++	– –	0	0	0	0			0	0	
Monophasic in both sexes												
Weight	– –	++	– –	0	+	– –	+++			+++		
Height	–	+	– –	–	+	–	0			+		
Sitting height	–	++	– –	0	0	–	–			0		
Thorax circ. (nipple)	0	++	– –	0	0	0	+			+		
Thorax circ. (xiphoid)	0	++	– – –	0	–	– –	0			0		
Abdominal circ.	– – –	++	– –	0	+	–	0			0		
Hand length	0	+	– – –	–	+	– – – –	–			0		
Monophasic in ♂ males Polyphasic in females												
Trunk width	– –	– –	– – –	– –	0	– – – –	– –	–	+1 5	+		
Cephalic breadth	0	0	0	0	–	–	– – –	(a) – – – – –	+1 0	– – –		
								(b) – –	+3 0			
Monophasic in females Diphasic in males												
Trunk depth	– –	++	– –	0	–	– – – –	0			–	+	+0 5
Diphasic in both sexes												
Sexually concordant												
Total arm length	–	+	– –	–	0	– – –	+	–	+1 5	+	–	+1 0
Arm length	– –	+	– –	–	0	– – –	+	– –	+1 5	+	–	+1 0
Leg length	–	+	– –	–	+	– –	+	– –	+1 5	+	–	+1 0
Neck girth	– –	+	– – –	– –	–	– – –	– – –	–	+0 5	– –	+	0
Sexually discordant												
Bisacromial width	++	++	– –	0	+	++	+	0	+1 5	–	+	+1 0
Bispinous width	–	++	++++	++	0	– –	–	++	+2 0	–	– – – –	+0 5
Cephalic length	+	+	– – – – –	– –	–	– –	– – –	– – – – –	+2 0	– – – –	– –	0

It is unfortunate that measurements are lacking for trunk width and depth at the level of the umbilicus Such data might well reveal an underlying sex difference in body shape as at nipple level In this context, it is also appropriate to call attention to the partition of total stature between head-plus-neck, trunk, and legs Table XIV shows that trunk length contributes rather less than one-third to total height, and that the ratio tends to decrease slightly in boys and to increase in girls Throughout our age-range, sitting height is a little over half of total stature of boys and girls alike The ratio is greater for boys than for girls of the youngest age group, but the two differ little in the oldest group Proportionately, the leg of a girl is somewhat longer than that of a boy at all ages It contributes just over 50 per cent to total height and increases relative to height in both sexes Both trunk length and leg length of girls increase in proportion to total stature while the proportionate contribution of sitting height decreases We may infer, therefore, that the contribution of head-plus-neck to total height undergoes a slight progressive decrease in the female Leg length of boys becomes greater relative to height, while sitting height and trunk length decrease their contribution to total stature Seemingly, therefore, head-plus-neck height does not change appreciably

Limbs—Growth of arm length (to wrist) and leg length (to ankle) alike accelerate at the beginning of puberty (*c* 11 25 and 13 25 years in girls and boys respectively), i e at the same time as, and in the same proportion to, acceleration of trunk length There is subsequently a decrease of relative growth Thus the limbs are synchronized in showing an early falling-off of growth, with early attainment of their size limit Less certainly, the hand shows a similar tendency for early decline of relative growth Since the hand of younger girls is longer than that of boys of the same age, total arm length is isomorphic for the group aged 8½-9 years Subsequently, the male hand grows more rapidly than the female, and total

arm length is greater in boys for our oldest group The leg of the female is considerably longer in relation to the arm (including hand) than is that of the male (Table XIV) throughout our age-range, whilst both increase more rapidly in relation to trunk length in boys

Arm length has an S G C of 1 47 in boys, subsequently falling to 0 79 some time after the onset of puberty, the corresponding figures for girls being 1 43 and 0 57 The S G C of hand length, concerning which there was insufficient evidence for the putative second phase of diminished growth, is 1 10 for boys and 0 79 for girls, a lower net rate of relative growth than that of arm length The allometric approach thus offers substantial evidence to support the postulate of a proximal-distal gradient of growth-potential This may signify that the more distal part of the organ grows more slowly than the proximal region, or that it is more refractory to stimuli

Head—The scatter of each of our three cephalic measurements is greater than for most other dimensions From what has been said in Section 3, we should expect cephalic length to become greater relative to cephalic breadth in boys and the converse to be true of girls Fig 6 depicts the trends and Table XVI presents the numerical data There is for boys a slight decrease and for girls a lower rate of increase of the cephalic index (C I) relative both to age and to trunk length By plotting the C I for girls

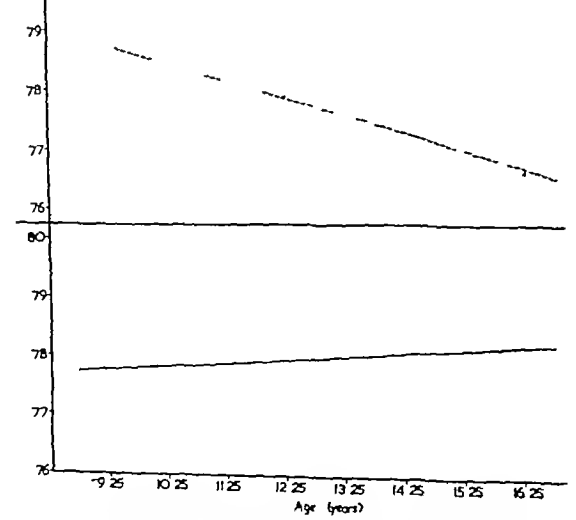

FIG 6—Age-group means and summarizing trends for Cephalic Index

TABLE XVI
CEPHALIC INDEX
TRENDS IN RELATION TO AGE AND TRUNK LENGTH

	Slope	
	Boys	Girls
C I × Age	−0 1516	+0 0257
C I × Trunk length	−0 0853	+0 0144

against that for boys on a logarithmic scale, it is impossible to discern any concurrence between the sexes Our results substantiate the general conclusion that the mean C I increases in a female population and decreases in a male population, and that the two trends cross during puberty at the estimated age of 12 years In other words, boys seem to be more dolichocephalic than girls before the age of 12, and after 12 more brachycephalic, but the variability which our observations disclose, whether attributable to insufficient refinement of measuring technique or inherent in the population (or, as is more likely, *ascribable to both*), compels us to state this conclusion with caution

Fig 7 (overleaf) is a calendrical visualization of our estimation of the time relations of the main features of the sexual metamorphosis, including those investigated in Part I of the present studies Dimensions specifically exhibiting a spurt or deceleration relative to trunk length have been distinguished by asterisks At the upper limit of our sample, 17 years, growth is continuing in both sexes, presumably at decreasing absolute rates As growth slows down, allometric analysis may become increasingly unreliable as the relative fluctuation of measurements tends to increase

We define the onset of puberty arbitrarily as the age at which the first qualitative indication appears We have seen that this coincides with a spurt of growth along certain dimensions, and there may well be other and earlier signs of pubescence outside the scope of our observations Our method of estimating the age at which growth accelerates is subject to an error of about six months, being dependent on the localization of discontinuities in a diphasic or triphasic pattern of growth With due regard to this *caveat*, salient features emerging from a study of time relations are (*a*) that girls anticipate boys by 2-2½ years in the onset of sexual maturation, (*b*) that in both sexes successive manifestations of puberty may overlap, (*c*) that with respect to allometric growth boys appear to undergo a more intense process of shorter total duration

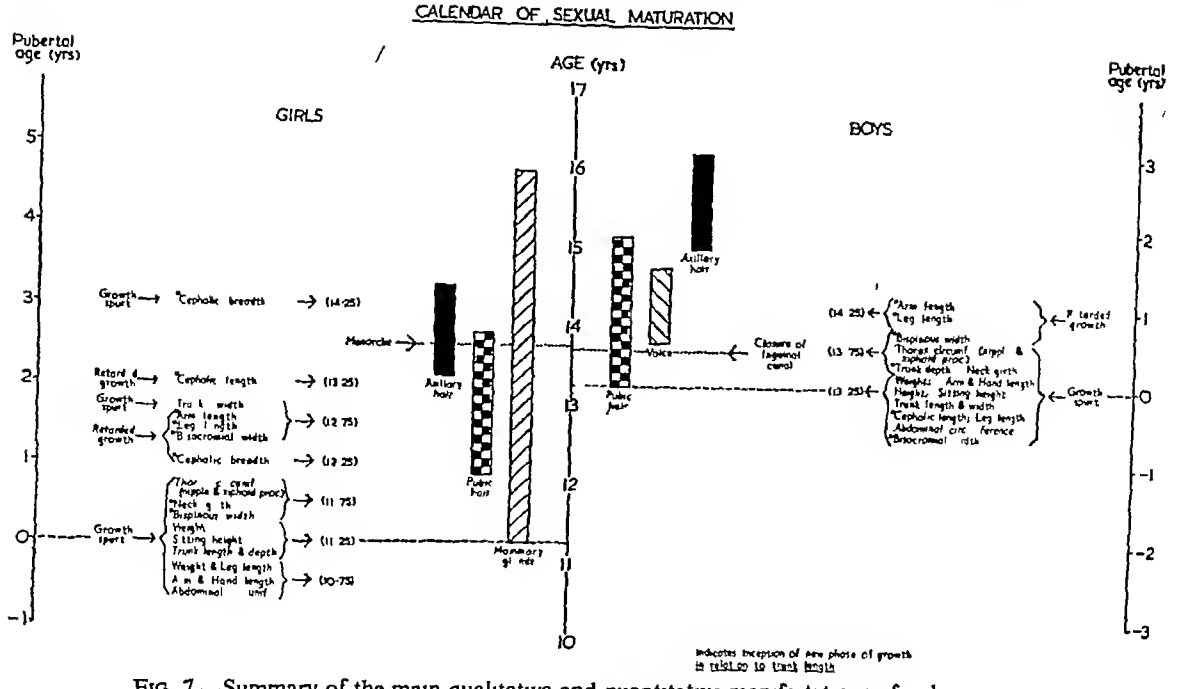

FIG 7.—Summary of the main qualitative and quantitative manifestations of pubescence

The previous communication (Hogben and others, 1948) focused attention on sex-specificity of pubescent growth of the bispinous and bisacromial dimensions and neck girth. Provisional conclusions there advanced were (i) that a male hormone is decisive for neck growth, (ii) that a female hormone is decisive for accelerated growth of the pelvis, (iii) that the male and female gonads may exercise a contrary influence on bisacromial width, possibly indicative of the existence of a male growth-promoting and a female growth-retarding hormone.

If sex hormones alone are indeed responsible, directly or indirectly, for the secondary characteristics of the sexual metamorphosis, we have at our disposal several possible hypotheses, of which it will suffice to specify three. (*a*) the secretion of a different hormone by each sex, the two having some effects in common, others opposite, (*b*) the production of two hormones by each sex, one sex-specific and one common to males and females, (*c*) a quantitative difference between the relative concentrations of two hormones, each present in each sex. At the same time we must allow for the possibility, and indeed the likelihood, of special, and sexually differential, threshold responses of specific regions or organs to one and the same hormone. It is somewhat unlikely that the female pelvis would be stimulated to increased growth, and the male pelvis to retarded growth, as a result of the activity of the same hormone in the same, or even in different, concentrations. Similar considerations apply to shoulder width and cephalic length.

Whilst we can come to no definite conclusion, the most attractive hypothesis we might formulate, if exclusively to explain our own results, is (*b*) above. The widely-held, but not satisfactorily established, conception of the presence of closely related groups of androgens and oestrogens in different relative intensities in the two sexes is *en rapport* with, but not a necessary condition for, our findings. Androgens are commonly held to have a growth-stimulating and trichogenic effect, and may be associated with our postulated common factor whilst oestrogens have effects specific to the female. A more satisfactory possibility is that the presence of the androgen group of hormones is associated with the features of puberty common to both sexes and specific to the male, and that oestrogens are largely responsible for specifically female characteristics. This hypothesis is supported circumstantially by our analysis, as well as by evidence both from experimental physiology and from endocrine pathology, nor should we forget that production of androgen-like substances as well as oestrogens by the ovary has been established more conclusively than the existence of both groups in the male. Also the more gradual onset of the growth spurt in the female may be due to a lower concentration of androgens, either

relatively or absolutely, than in the male Until a critical appraisal of the literature relating to experimental physiological and pathological approaches to the study of sex hormones has been made, and augmented by crucial experiment, it will not be possible to formulate a more satisfactory explanation of causal mechanisms operative during puberty It is not even possible to assert with confidence that the accelerated growth of the body at puberty is a direct result of gonadal secretions, increased secretion of the anterior lobe pituitary growth hormone may be the immediate stimulant of pubertal growth It is, however, convenient, within the limits of the information at present at our disposal, to regard the events shown in Fig 7 as consequent upon the onset of the secretory activity of the ovary and the testis

We have demonstrated that the event usually taken as the signal of puberty in females, the onset of menstruation, does not in fact occur until over two years after other diacritical events It appears that the cyclical activity of the ovary is a threshold effect of hormone concentrations, and this is supported by the frequent irregularities of the menstrual cycle during adolescence Definition of the onset of puberty by menarche, though etymologically permissible, is physiologically misleading

It is outside the range of the present communication to discuss relative somatic proportions of males and females in the adult state, but an interesting possibility suggests itself to explain the larger size of the adult male, already apparent in our oldest age group At the age of 9, girls exceed boys in height, weight, and several other dimensions representative of body size in general, and at the beginning of puberty there is in both sexes a spurt in growth of the body as a whole According to the bulk of published evidence, absolute growth follows an approximately logarithmic curve In any case it slows down after acceleration at puberty, and eventually comes to a standstill approximately 10 years later Since boys start puberty two years after girls, we might expect them to stop growing later Other things being equal, men might well therefore be, as in fact they are, larger than women in virtue of two additional years of prepubertal growth, but possibly also contributory to the greater size of the human male is a slightly greater intensity both of prepubertal growth and of the pubertal spurt

Conclusions

1 The allometric equation $y=kx^b$ is satisfactory as an empirical method of analysis of the morphogenetic pattern of human prepubertal and pubertal development

2 Special attention should be focused on the method of curve-fitting in the application of this and other growth equations A method of fitting (least square-perpendiculars) has been found more suitable and is also satisfactory *vis à vis* goodness-of-fit criteria

3 Females start puberty 2-2½ years earlier than males, the inception is marked by the start of the enlargement of the mammary glands in the female and by the appearance of pubic hair in the male, concurrently with the onset of a tempo of more intense growth along nearly all dimensions in both sexes

4 Trunk length is virtually a sexually invariant dimension with reference to rate of growth and absolute size, and is therefore *de facto* a suitable basis for the comparison of specific growth rates of other dimensions in the same and opposite sexes Accordingly, we speak of the *specific growth rate* of a particular dimension as its growth relative to that of the trunk

5 During puberty, there is no noteworthy alteration for either sex of the tempo of growth of the following dimensions relative to trunk length

- Weight
- Height
- Sitting height
- Thorax circumference (at nipple and xiphoid process)
- Abdominal circumference
- Hand length

6 Change of the specific growth rate at some time during puberty is characteristic of certain dimensions as indicated below

(*a*) *in females alone*
- Trunk width (acceleration)
- Cephalic breadth (retardation one year after, and acceleration three years after, inception of puberty)

(*b*) *in males alone*
- Trunk depth (acceleration)

(*c*) *in both sexes*
- Arm length, with and without hand (retardation)
- Leg length (retardation)
- Neck girth (acceleration, more intense in males)
- Bisacromial width (acceleration in male, retardation in female)
- Bispinous width (retardation in male, acceleration in female)
- Cephalic length (acceleration in male, cessation of growth in female)

7 Limb growth (arm and leg) undergoes a spurt at the onset of puberty and declines thereafter more steeply than growth of the trunk

8 The following dimensions exhibit a well-defined heteroplasia in our age range

(*a*) *Positively heteroplasic* (female grows faster)
- Bisacromial width (prepubescent* only)
- Bispinous width (postpubescent† only)

(*b*) *Negatively heteroplasic* (male grows faster)
- Hand length
- Trunk width
- Arm length (with and without hand)
- Leg length
- Neck girth
- Bisacromial width (postpubescent)
- Bispinous width (prepubescent)
- Cephalic length (postpubescent)

9 The following dimensions are characterized by sexual dimorphism in childhood (at 8 75 years)

(*a*) *Positive* (larger size in female)
- Weight
- Height
- Abdominal circumference
- Leg length
- Bisacromial width

(*b*) *Negative*
- Trunk depth
- Neck girth
- Cephalic length
- Thorax circumference (xiphoid process)
- Cephalic breadth

10 The following dimensions are significantly dimorphic in adolescence (at 16 75 years)

(*a*) *Positive*
- Bisacromial width (dimorphism decreasing)
- Bispinous width (dimorphism increasing)

(*b*) *Negative*
- Weight
- Height
- Sitting height
- Abdominal circumference
- Leg length
- Trunk length
- Trunk depth
- Neck girth
- Arm length (with and without hand)
- Hand length
- Thorax circumference (xiphoid process)
- Cephalic length
- Cephalic breadth

11 From these conclusions it is possible to derive a composite picture of differential body-shape with reference to sex (*a*) males become thicker and broader in the trunk, and longer in the leg, than females, (*b*) thoracic circumference becomes slightly greater in males, because the increased trunk depth and width compensates for the enlargement of the breasts in the female

12 Cephalic measurements (length, breadth, and bizygomatic width) show more variability between mean values for successive age-groups, especially in males, than is characteristic of other dimensions Bizygomatic width is greater in girls but shows too much fluctuation to be amenable to satisfactory estimation of relative growth Over the whole range of 8½-17 years, the cephalic index shows a slight increase in girls, but at 12 years there is no apparent sex difference In so far as our sample is representative, we may therefore say that before the age of 12 a female population is on the average more dolichocephalic than a male population, and that after 12 it is more brachycephalic

13 It is often stated that the relationship between weight and height can be expressed in the form

$$W \propto H^3$$

A more exact relationship appears to hold good as a sexually differential characteristic within our age-range

males $W \propto H^{2\cdot78}$
females $W \propto H^{3\cdot35}$

The growth ratio of weight to trunk length is more sexually invariant

males $W \propto T^{3\cdot32}$
females $W \propto T^{3\cdot09}$

14 At the age of 17, boys are larger than girls with respect to all the main dimensions of the body, except pelvic width, shoulder width, and bizygomatic width It is suggested that a contributory cause of the larger size of the human adult male is the delayed release of the sex hormone (or hormones), with a subsequent delay of two years in the final decline of body growth, i e the female undergoes two years' prepubescent growth less than the male

We are deeply indebted to Professor Lancelot Hogben, F R.S , who designed the enquiry as a whole and suggested the approach explored in this communication, for his constant encouragement and advice, and to Miss G Haines for preparing the charts One of us (R.H C) was in receipt of a grant from the Medical Research Council during this investigation

* before the inception of puberty
† after the inception of puberty

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CONGENITAL MALFORMATIONS OF THE CENTRAL NERVOUS SYSTEM

I—A SURVEY OF 930 CASES*

BY

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INTRODUCTION

Of the causes of stillbirths and infant mortality which have not shared in the general improvement during the last fifty years easily the most important are the congenital malformations At the beginning of the present century, when ideas about their aetiology were turning from mysticism to morbid anatomy, their investigation could have been regarded as an interesting academic exercise, which might add something to knowledge of the intra-uterine environment or of human genetics, but could make no considerable contribution to the accountancy of preventable deaths This is not the position to-day The intervening years have added little to our knowledge of the aetiology of the malformations, but the effectiveness of preventive measures against other causes of infant death before and after birth has enormously altered their relative contribution to the total deaths In the white population of New Zealand, for example, they recently accounted for nearly one-fifth of the deaths under one year (Leitch, 1944), and these figures are being approached in this country, where infant mortality attributed to malformations has shown a slight absolute and a large relative increase (Table I) Scottish data for stillbirths and first-year deaths show that in the six years to 1945, 10 per cent of all foetuses that reached viable age were born dead or died in the first year of life, more than 10 per cent. of these deaths were ascribed to congenital malformations (Table II, overleaf) Expressed differently, 1 per cent of all foetuses alive in the 28th week of pregnancy died from congenital malformations before the first birthday

CAUSATION—The subject has been reviewed extensively (Warkany, 1947, Gruenwald, 1947), and it will suffice to recall the results of the main lines of enquiry In lower animals, where the embryos are in intimate contact with a changing environment, it was readily demonstrated that external factors can modify the course of embryonic development Unspecific physical agents, such as *x* rays, ultra-violet light, mechanical shaking or temperature changes, and a large number of chemical agents which inhibit growth, gave rise in a variety of species to congenital deformities The application of some of this work to the more uniform uterine environment of mammals is doubtful, but there is also evidence from the animal laboratory that the mammalian foetus may be deformed by external influences On the other hand, certain malformations in animals are undoubtedly genetically determined, though some of them bear little resemblance to the common human deformities

It is difficult to assess the relevance of this evidence, much of it on invertebrates and lower vertebrates, to the corresponding problem in man The

TABLE I†

QUINQUENNIAL INFANT MORTALITY RATES FOR ENGLAND AND WALES (1901–1945)

Period	Infant Deaths per 1,000 Live Births		Rates expressed as a percentage of those from 1901 to 1905	
	From Congenital Malformations	From all Causes	From Congenital Malformations	From all Causes
1901–05	4 33	138	100	100
1906–10	4 94	117	114	85
1911–15	3 85	110	89	80
1916–20	4 04	90	93	65
1921–25	4 32	76	100	55
1926–30	4 94	68	114	49
1931–35	5 85	62	135	45
1936–40	6 11	55	141	40
1941–45	*5 97*	*50*	138	36

† Martin, W J (1949) *Brit med J* 1 438

* This research was assisted by a grant from the Birmingham University Students Social Service Fund

TABLE II*

STILLBIRTH AND INFANT MORTALITY RATES FOR SCOTLAND (1939–1945)

Year	Stillbirths per 1,000 Total Births		Infant Deaths per 1,000 Live Births		Combined Stillbirths and Infant Deaths per 1,000 Total Births		Contribution of Malformations to Total Deaths
	From all Causes	From Foetal Defects	From all Causes	From Congenital Malformations	From all Causes	From Congenital Malformations	%
1939	42 2	5 83	68 5	6 35	107 9	11 9	11 0
1940	42 1	6 09	78 3	6 05	117 1	11 9	10 1
1941	39 6	6 53	82 7	6 81	119 0	13 1	11 0
1942	38 2	5 71	69 3	7 12	104 8	12 6	12 0
1943	35 6	6 07	65 2	6 21	98 5	12 1	12 3
1944	32 5	5 93	65 0	5 96	95 4	11 7	12 3
1945	33 0	6 65	56 2	5 56	87 2	12 0	13 8
1939–1945	37 5	6 11	69 3	6 30	104 2	12 2	11 7

* Annual Reports of the Registrar General for Scotland (1939-1945)

importance of the uterine environment has been stressed by pathologists who have cited the high incidence of pathological embryos in ectopic pregnancies, and in association with placenta praevia where the ovum embeds in or near the lower uterine segment It has been suggested that some deformities are produced mechanically by pressure on the foetus, but this is unlikely to explain the more common and more lethal malformations Infections in the mother during pregnancy have also been considered since the report that a history of rubella could be elicited in a number of cases, most observations on this subject are open to the criticism that the association may be fortuitous, for as a rule the incidence of the disease in pregnant women who produce normal children is unknown

Conclusive evidence about the influence of heredity in man is available only for the exceptional malformations in which the recorded incidence in families is in accord with the known laws of inheritance In many other malformations an incidence higher than average is observed in the relatives of a malformed propositus, but this information does not, of course, permit us to separate environmental and genetic effects Twin studies are few, and must be interpreted cautiously in view of the special difficulty of establishing the homozygosity of a uniovular pair

It is an indication of our increased awareness of the difficulties that we are no longer content to examine as exclusive alternatives the possibilities of genetic or environmental causes for most observations in human beings In this matter we are indebted particularly to Hogben (1933), who has drawn our attention to the extent to which we have been misled by the emphasis on experience of highly standardized animal stocks, observed in the laboratory under carefully controlled conditions On existing evidence we can neither support nor dismiss the possibility of a contribution from inheritance to the origin of most malformations, but must accommodate in our conception the interdependence of genetic and environmental variables, with the attendant difficulty of assessing the relative contribution of each The congenital malformations have now been considered from this viewpoint (Lenart, 1941, Gruenwald, 1947, Penrose, 1948, Holt, 1948) and the question will be examined more fully in a later communication

SOURCES OF DATA —In collecting data on human malformations we are handicapped by the fact that there are no satisfactory sources of information about individuals for whom the malformation is not certified as the cause of death We may conveniently consider sources of data in relation to deaths at four different periods

(*a*) *Deaths in utero before the 28th Week of Gestation* —Stillbirths are not notified in Great Britain until the 28th week of gestation,† and for information earlier than this time we rely mainly on observations of pathologists who examine the aborted foetus (for example, Mall, 1917, Hertig and Livingstone, 1944) Inevitably such reports are incomplete, since only a proportion of abortions come to medical attention This source is occasionally supplemented by material which becomes available at operations on the pregnant uterus (Rock and Hertig, 1948)

† This date is not the same in every country

TABLE III

INCIDENCE OF MALFORMATIONS IN HOSPITAL SERIES

Country, Author, and Date	Place	Total Numbers of Births in Series	Malformations per 1,000 Births (not necessarily fatal)	Stillbirths due to Malformations per 1,000 Total Births	Neonatal Deaths due to Malformations per 1,000 Live Births	Remarks
United Kingdom						
Malpas, 1937	Liverpool	13,964	21	—	—	50% of malformations were cerebrospinal.
Allen, Macaffee, and Biggart, 1943	Belfast	6 314	—	—	7 3	49% of malformations were cerebrospinal
Baird, 1947	Aberdeen	3,296	—	4 9	5 3	Primiparae only
Drillien, 1947	Edinburgh	7,599	—	9 3	5 4	—
America						
Javert and Stander, 1943	New York	27,000	29 5	—	—	Includes a number of minor malformations
D'Esopo and Marchetti, 1942	New York	25,823	5 5	—	—	Includes only fatal malformations
Newton and McLean, 1947	Bridgeport	15,421	8 4	—	—	65% of malformations were cerebrospinal
Potter and Adair, 1943	Chicago	27,321	—	2 4	2 4	35% of malformations were cerebrospinal
Potter and Dieckmann, 1948	Chicago	17,657	—	1 2	2 9	—

(*b*) *Deaths* in utero *after the 28th Week of Gestation*—After the 28th week stillbirths are notified, and from this time national statistics record information extracted from the notification card In England and Wales this does not include the certified cause of the stillbirth, but since 1939 the cause has been recorded by the Registrar-General for Scotland, adding greatly to the value of the data which can be extracted on malformations

(*c*) *Deaths in the First Year of Life*—In England and Wales as well as in Scotland, the cause of subsequent death is, of course, certified for live births, and the record is particularly useful in the case of the more lethal malformations which cause death in the first year of life

(*d*) *Deaths after the First Year of Life*—Information about malformed individuals who die after the first year of life is less satisfactory, since the fact of survival to this date indicates that the malformations are less serious, and therefore less likely to appear ultimately as the cause of death

National statistics are, of course, subject to errors of diagnosis Malformations such as anencephalus and spina bifida are unlikely to be missed, but others are not reliably diagnosed without an autopsy On the other hand, it is probably not uncommon for the presence of an internal malformation to be inferred where it does not exist, or for deaths due to other causes to be attributed to malformations For example, it is likely that the deaths of some infants born in a state of asphyxia livida are erroneously certified as due to congenital heart disease (Cruickshank, 1930) Yet another source of error is introduced by the incrimination of a relatively minor malformation (for example, hare-lip or cleft palate) as the cause of a stillbirth or death when the real cause is unknown

In view of these difficulties, records of hospitals where a high proportion of cases were examined post mortem are of interest (Table III) The fact that the reported incidence of congenital malformations varied greatly from one hospital to another

TABLE IV*

STILLBIRTHS AND INFANT DEATHS DUE TO CENTRAL NERVOUS MALFORMATIONS IN SCOTLAND (1941–1945)

Year	Stillbirths			Infant Deaths		
	Due to all foetal defects	Due to anencephalus, spina bifida, and hydrocephalus	Percentage of Malformations involving Central Nervous System	Due to all Congenital Malformations	Due to spina bifida and hydrocephalus	Percentage of Malformations involving the Nervous System
1941	610	391	64	611	241	39
1942	538	472	88	646	266	41
1943	596	399	67	588	231	39
1944	588	396	67	572	215	38
1945	598	442	74	483	171	35
Total	2,930	2,100	72	2,900	1,124	39

* Annual Reports of the Registrar General for Scotland (1941 1945)

indicates, as might be expected, that representative statistics cannot be collected from this source It is also possible to supplement the sources of data listed above by field enquiry This method has been used with profit by Penrose (1934, 1946) and Murphy (1940) We have therefore chosen to collect information by field enquiry on all malformations of certain specified types notified to a large Local Authority over a period of years

THE PRESENT ENQUIRY —The evidence suggests that congenital malformations in man do not form a homogenous group of uniform aetiology, and this view is supported by observations of the sex ratio the proportion of males to females in pyloric stenosis is four to one, and in anencephalus one to three, the sex ratios of other malformations lie between these extremes Investigations are therefore more likely to be of value if restricted to one type of deformity which occurs with sufficient frequency to furnish adequate numbers, and for this reason, we have confined our attention to the malformations of the nervous system Table IV shows that in the years 1941 to 1945 in Scotland, they accounted for at least† 72 per cent of stillborn and 39 per cent of live born malformations which died in the first year of life, or for 55 per cent of the combined total (5,830) The total births in the same period were 474,959, and central nervous malformations were thus responsible for the deaths of 0 68 per cent of all infants born

Study of this group has the further advantage that its members are readily identified at birth from external appearances so that errors of diagnosis are unlikely, except occasionally in hydrocephalus, where perforation of the head may be necessary to effect delivery, and in the premature infant where the relatively large head may be erroneously diagnosed as hydrocephalus Notifications of stillbirths and infant deaths ensure the collection of all cases of anencephalus, and of almost all cases of spina bifida with occasional exceptions such as spina bifida occulta and mild examples of meningocele The only serious statistical loss consists of those cases of hydrocephalus compatible with life for a number of years A few deaths of infants from acquired hydrocephalus may also be erroneously attributed to congenital causes, where the history of infection is overlooked

We were fortunate in having access to the records of the Maternity and Child Welfare Department of the City of Birmingham, which for a number of years has obtained information on all stillbirths and neonatal deaths, by means of a questionnaire completed by the doctor or midwife in charge of the case When returned, the form is scrutinized by a medical officer of the department, and the information entered into a register From this register, we extracted information for the eight years 1940 to 1947 about all malformations of the central nervous system which were certified as the cause of death of stillbirths or of infants in the first year of life The data available from this source for stillbirths and neonatal deaths were

(1) name address and municipal ward,
(2) date and place of birth
(3) sex, single or twin, legitimacy,
(4) brief details of results of previous pregnancies,
(5) details of all malformations, and other conditions contributing to death

† Not all malformations of the nervous system are shown separately

TABLE V

THE NUMBERS OF CENTRAL NERVOUS MALFORMATIONS OF DIFFERENT TYPES IN 930 CONSECUTIVE CASES BORN IN BIRMINGHAM (1940–1947)

Group	Sub-group**	Number of			Total
		Stillbirths	Neonatal Deaths	Later Infant Deaths	
Anencephalus	1 Anencephalus alone*	314	18	—	332
	2. Anencephalus and spina bifida	33	1	—	34
		347	19		366
Spina bifida	3 Spina bifida alone*†	49	144	62	255
	4 Spina bifida and hydrocephalus	68	56	5	129
	5 Spina bifida and encephalocele	2	2	—	4
	6 Spina bifida, hydrocepbalus, and encephalocele	1	—	—	1
		120	202	67	389
Hydrocephalus	7 Hydrocephalus alone*	112	24	14	150
Others	8 Encephalocele alone*	2	9	—	11
	9 All other central nervous malformations‡	3	6	5	14
		5	15	5	25
Total Central Nervous Malformations		584	260	86	930

* Excludes the co-existence of a second central nervous malformation
† 'Spina bifida' includes spinal meningocele meningomyelocele and myelocele.
‡ Other central nervous malformations were microcephalus—8 unspecified congenital cerebral defect—4 occipital meningocele—2
** Numerals are referred to in Fig 1

For live births, the date and place of death were also recorded The details listed above are now collected for all infant deaths in the city, but for seven of the eight years covered by the survey the only data available from central sources for deaths after the neonatal period, were the name and address, age at death, place and cause of death In such cases there was no difficulty in completing the record in the course of the subsequent investigation

Visits were made to the homes of all mothers of the malformed births, and of a control group of approximately equal size, obtained by selecting every two-hundredth name in the registers of live and still births for the same years (1940 to 1947) The visits were completed in the period November, 1947, to October, 1948, by a team of female investigators, most of whom had been trained as almoners or in some other branch of social work In each case where the mother could be interviewed at her original home or elsewhere in the city a field enquiry card was completed with her assistance Information was recorded as follows

(1) menstrual history (age at onset, mean length of the cycle, duration of flow),
(2) age at marriage,
(3) reproductive history (details of all conceptions),
(4) history of the pregnancy resulting in the birth of the propositus (illness, work during pregnancy),
(5) information about the father (age, occupation blood relationship to the mother),
(6) rent (included as an index of social circumstances),
(7) family history of congenital malformations

No attempt was made to trace mothers who had left the city, the proportions lost in the malformation and control series are discussed below

OBSERVATIONS ON 930 CONSECUTIVE MALFORMATIONS OF THE CENTRAL NERVOUS SYSTEM§

CLASSIFICATION AND INCIDENCE.—In the years 1940 to 1947, malformations of the central nervous system were certified in Birmingham as the cause of death of 930 stillbirths and first year deaths Table V (see also Fig 1, overleaf) gives the numbers attributed to each type of malformation, which have been grouped into four main divisions anencephalus, spina bifida, hydrocephalus, others This is the classification suggested in the International

§ Data from Maternity and Child Welfare Department records

TABLE VI

STILLBIRTH AND INFANT MORTALITY RATES DUE TO MALFORMATIONS OF THE CENTRAL NERVOUS SYSTEM IN BIRMINGHAM (1940–1947)

Type of Malformation	Stillbirth rate per 1,000 Total Births	Infant Mortality rate per 1,000 Live Births	Total Deaths per 1,000 Total Births
Anencephalus	2 192	0 123	2 312
Spina bifida	0 758	1 747	2 457
Hydrocephalus	0 707	0 247	0 948
Others	0 032	0 130	0 158
Total	3 689	2 247	5 875

Statistical Classification of Diseases, Injuries, and Causes of Death (1948), which does not, however, show where births with more than one malformation (for example, spina bifida with hydrocephalus) are placed The three groups, anencephalus, spina bifida, and hydrocephalus, are also used by the Registrar-General for Scotland in his valuable statistics on stillbirths, but the fact that the precise composition of the divisions is not indicated does not permit us to identify them with our own, and he includes all other malformations of the central nervous system with "other specified defects'

If the data are grouped, the placing of combined malformations is important in two types which are comparatively common in Birmingham records anencephalus with spina bifida, and spina bifida with hydrocephalus Differences in the proportion of stillbirths and in the sex ratio of each malformation suggest the need for caution in allocating to any of the three main divisions births in which two malformations are combined We have included "anencephalus with spina bifida" in the anencephalus group, since 33 of the 34 foetuses were stillborn, and anencephalus is the more lethal malformation "Spina bifida with hydrocephalus", is included with spina bifida, we were influenced by the fact that spina bifida is the more reliable diagnosis, although in this case the proportion of stillborn infants with the combined lesions is almost mid-way between the proportions in each of the two component groups

During the eight years 1940 to 1947, the total number of births in Birmingham was 158,307, of which 4,290 were stillbirths and 154,017 live births From these figures, the numbers in Table V have been converted into rates which are shown in Table VI The total incidence of fatal malformations of the nervous system in Birmingham (0 5875

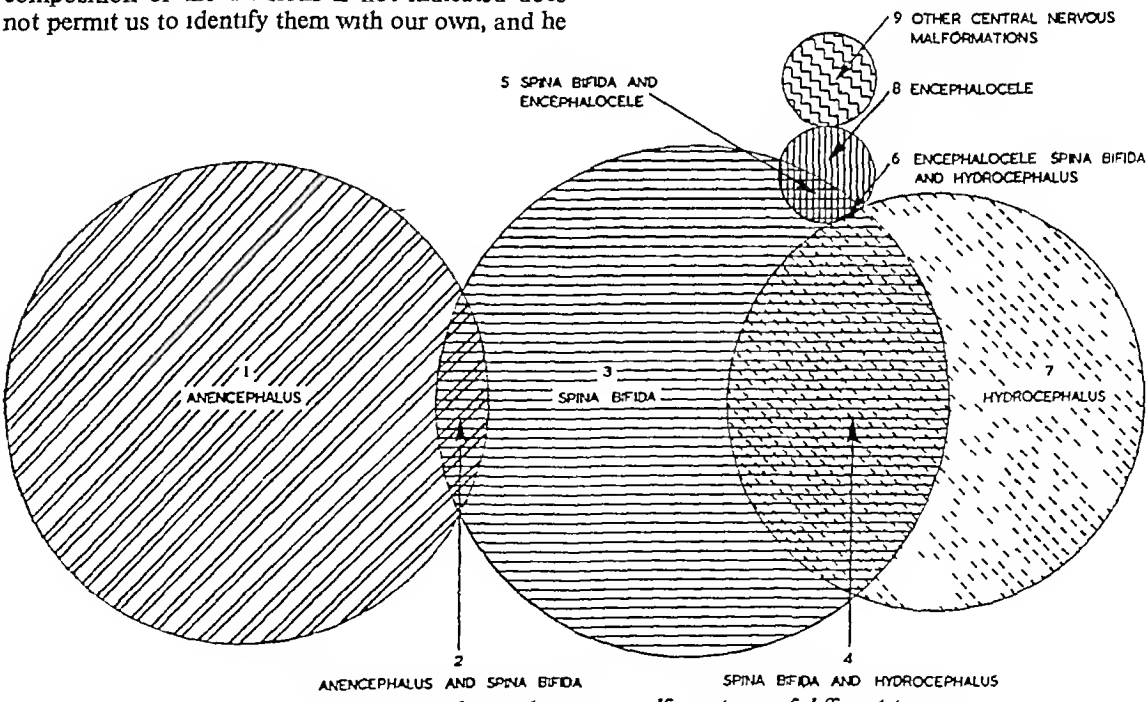

FIG 1 —Combinations of central nervous malformations of different types

TABLE VII

NUMBERS OF CENTRAL NERVOUS MALFORMATIONS OF DIFFERENT TYPES FOUND IN 930 CONSECUTIVE CASES IN BIRMINGHAM (1940–1947)

Type of Malformation	Number	Incidence (per 1,000 Births, Live and Stillborn)
Anencephalus	366	2 312
Spina bifida	423	2 672
Hydrocephalus	280	1 769
Encephalocele	16	0 101
Others	14	0 088
Total	1,099	6 942

per cent) is slightly below the Scottish figure (0 68 per cent) for 1941 to 1945, as is the stillbirth rate of 2 192 due to anencephalus compared with the Scottish rate of 2 549 for the years 1939 to 1945 As already indicated, these data are not strictly comparable, although the error in the figures here compared is probably not great

CO-EXISTENCE OF NERVOUS MALFORMATIONS —The comparatively high incidence of two distinct malformations of the central nervous system in one individual is not explained by their chance association The total number of central nervous malformations of different types in the 930 affected individuals in the series are given in Table VII in which two malformations in the same foetus are entered separately If the co-existence of malformations were entirely fortuitous, the incidence of the combination would be the product of their frequencies,

TABLE VIII

EXPECTED AND OBSERVED NUMBERS OF VARIOUS COMBINATIONS OF CENTRAL NERVOUS MALFORMATIONS

Combination	Expected Frequency per 1,000 Births	Expected Number in Universe of 158,307 Births	Observed Number in Universe of 158,307 Births
Anencephalus and spina bifida	0 006178	0 978	34
Hydrocephalus and spina bifida	0 004727	0 748	129
Encephalocele and spina bifida	0 000270	0 043	4
Hydrocephalus, encephalocele, and spina bifida	0 00000048	0 00008	1

TABLE IX

OTHER DEFORMITIES CO-EXISTING WITH MALFORMATIONS OF THE CENTRAL NERVOUS SYSTEM

Co-existing Deformity	Type of Central Nervous Malformation (Simplified Classification)				
	Anencephalus	Spina bifida	Hydrocephalus	Others	All
Exomphalos	9	2	—	1	12
Congenital heart	—	2	3	—	5
Hare-lip and/or cleft palate	—	3	—	1	4
Malformation of cord	1	1	—	—	2
Talipes	1	26	2	—	29
Other skeletal deformities	2	8	4	1	15
Other malformations	1	2	2	—	5
Multiple malformations	1	—	5	3	9
Total number of deformities	15	44	16	6	81
Number of individuals exhibiting these	14	42	16	5	77
Total number in group	366	389	150	25	930
Percentage of individuals with co-existing deformity	3 8	10 8	10 7	20 0	8 3

TABLE X

SEX INCIDENCE OF MALFORMATIONS OF THE CENTRAL NERVOUS SYSTEM IN BIRMINGHAM (1940–1947)

Type of Malformation	Number of			Sex Ratio (Number of Males per 1,000 Females)	Percentage of Males	Discrepancy between this percentage and 50% (which corresponds to a Sex Ratio of Unity)
	Males	Females	Both			
Anencephalus alone	109	223	332	489	32 83	17 17±2 58
Anencephalus with spina bifida	8	26	34	308	23 53	26 47±7 27
Spina bifida alone	108	146	254	740	42 52	7 48±3 10
Spina bifida with hydrocephalus	59	70	129	843	45 74	4 26±4 39
*Spina bifida with encephalocele	—	4	4	—	—	—
*Spina bifida with encephalocele and hydrocephalus	—	1	1	—	—	—
Hydrocephalus alone	65	85	150	765	43 33	6 67±4 04
*Encephalocele alone	6	5	11	—	—	—
*Other central nervous malformations	7	7	14	—	—	—
Total	362	567	929	638	38 97	11 03±1 60

* Numbers too small for calculation of sex ratio

TABLE XI

SEX INCIDENCE OF MALFORMATIONS OF THE CENTRAL NERVOUS SYSTEM IN BIRMINGHAM (1940–1947)

Type of Malformation (Simplified Classification)	Number of			Sex Ratio (Number of Males per 1,000 Females)	Percentage of Males	Discrepancy between this percentage and 50% (which corresponds to a Sex Ratio of Unity)
	Males	Females	Both			
Anencephalus						
Stillbirths	107	240	347	446	30 84	
Infant deaths	10	9	19	1,111	52 63	
Total	117	249	366	470	31 97	18 03±2 44
Spina bifida						
Stillbirths	43	76	119	566	36 13	
Infant deaths	124	145	269	855	46 10	
Total	167	221	388	756	43 04	6 96±2 51
Hydrocephalus						
Stillbirths	53	59	112	898	47 32	
Infant deaths	12	26	38	462	31 58	
Total	65	85	150	765	43 33	6 67±4 04
**Others*						
Stillbirths	2	3	5	—	—	—
Infant deaths	11	9	20	—	—	—
Total	13	12	25	—	—	—
All Central Nervous Malformations						
Stillbirths	205	378	583	542	35 16	14 84±1 98
Infant deaths	157	189	346	831	45 38	4 62±2 68
Total	362	567	929	638	38 97	11 03±1 60

* Numbers too small for calculation of sex ratio

and Table VIII (previous page) compares the expected and observed numbers The considerable differences between these two sets of figures indicate either that the presence of one malformation predisposes to the formation of another or that a common factor is concerned in their aetiology

TABLE XII

SEX INCIDENCE OF MALFORMATIONS OF THE CENTRAL NERVOUS SYSTEM IN SCOTLAND (1939–1945)

Type of Malformation	Number of			Sex Ratio (Number of Males per 1,000 Females)	Percentage of Males	Discrepancy between this percentage and 50% (which corresponds to a Sex Ratio of Unity)
	Males	Females	Both			
Anencephalus						
Stillbirths only	446	1,222	1,668	365	26 74	23 26±1 08
Spina bifida						
Stillbirths	120	182	302	659	39 74	10 26±2 82
Infant deaths	534	676	1,210	790	44 13	5 87±1 43
Total	654	858	1,512	762	43 25	6 75±1 27
Hydrocephalus						
Stillbirths	458	428	886	1,070	51 69	−1 69±1 68
Infant deaths	231	237	468	975	49 36	0 64±2 31
Total	689	665	1,354	1,036	50 89	−0 89±1 36
Total						
Stillbirths	1,024	1,832	2,856	559	35 85	14 15±0 90
Infant deaths	765	913	1,678	838	45 59	4 41±1 21
Total	1,789	2,745	4,534	652	39 46	10 54±0 73

ADDITIONAL MALFORMATIONS.—Of 930 infants born with one or more central nervous malformations, 77 (8 3 per cent) showed deformities of other organs (Table IX, p 189) The table illustrates the well-known association between talipes and spina bifida, due presumably to a disturbance of the nervous tracts supplying the lower extremities, and also suggests an association between exomphalos and anencephalus

SEX RATIO.—The sex incidence of 929 malformations* is given in Table X for all cases, and in Table XI for the three main divisions anencephalus, spina bifida, hydrocephalus Except for hydrocephalus, in which our numbers are small, the results are in reasonable agreement with the estimates calculated from Scottish data for the years 1939 to 1945 (see Table XII)

These differences are, of course, well recognized, although no satisfactory explanation is available for them If equal numbers of both sexes are malformed in the early weeks of gestation, more males must be aborted in the period before the birth is notifiable, and when the sex is often unknown Certainly the evidence does not suggest that males are less viable than females in the later months, for of the 929 Birmingham malformations, 43 4 per cent of males and 33 3 per cent of females were alive at birth The corresponding figures for spina bifida and hydrocephalus based on the Scottish statistics are given in Table XIIA

TABLE XIIA

SEX INCIDENCE OF SPECIFIC MALFORMATIONS ALIVE AT BIRTH SCOTLAND (1939–1945)

Malformation	Sex	Number of Cases	Percentage Live Born
Spina bifida	Male	654	81 7
	Female	858	78 8
Hydrocephalus	Male	689	33 5
	Female	665	35 6

The conclusion about the respective viability of male and female malformations would, of course, be affected if different proportions of the two sexes were alive at the end of the first year In his report on 144 malformations of the central nervous system, Penrose (1946) records 22 male and 24 female malformations which survived the first year Scottish data for the period 1941-1945 are also relevant (see Table XIIB, overleaf)

SECULAR TREND.—The annual numbers of malformations of the central nervous system notified in Birmingham (1940-1947) are given in Table XIII (overleaf), with the total numbers of live and still

* In one of the 930 cases the sex was not given.

TABLE XIIb

SEX INCIDENCE OF SPECIFIC MALFORMATIONS WHICH SURVIVED FIRST YEAR SCOTLAND (1939–45)

Malformation	Deaths after the First Year of Life		
	Males	Females	Total
Congenital hydrocephalus	43	25	68
Spina bifida and meningocele	12	21	33

births for the same years From these figures the rates exhibited in Table XIV and Fig 3 have been calculated Unlike the national rates relevant to all malformations cited in Tables I and II, the Birmingham rates of anencephalus and spina bifida show an unmistakable decline in the eight-year period, the rates of hydrocephalus are fairly constant Fig 2 indicates that the incidence of malformations has fallen at a relatively greater rate than the incidence of stillbirths from all causes

In accounting for this somewhat unexpected result, it is important to consider secular changes in

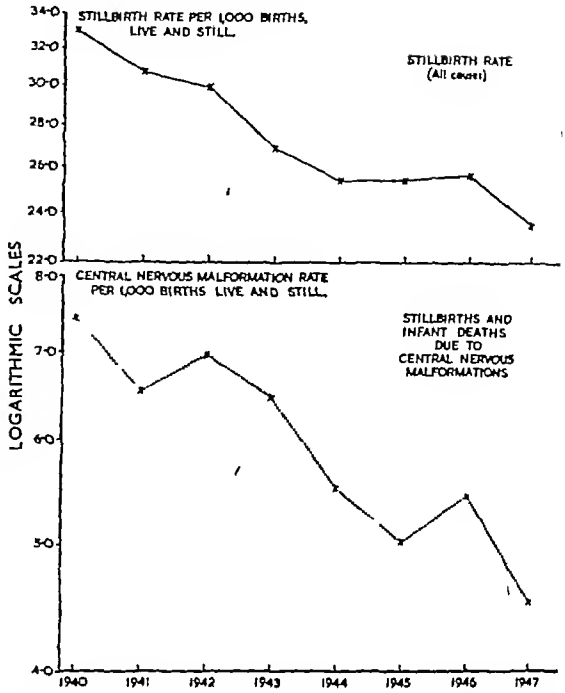

FIG 2—Annual rates for stillbirths (all causes) and for central nervous malformations (Birmingham, 1940-47)

TABLE XIII

ANNUAL NUMBERS OF MALFORMATIONS OF THE CENTRAL NERVOUS SYSTEM IN BIRMINGHAM (1940–1947)

Type of Malformation	Stillbirth or Infant Death	Year								Whole Period
		1940	1941	1942	1943	1944	1945	1946	1947	
Anencephalus	S B	43	37	47	53	47	42	41	37	347
	I D	5	2	1	—	1	3	1	6	19
	Total	48	39	48	53	48	45	42	43	366
Spina bifida	S B	23	13	12	14	17	10	17	14	120
	I D	32	25	47	39	37	28	35	26	269
	Total	55	38	59	53	54	38	52	40	389
Hydrocephalus	S B	11	14	12	17	13	9	21	15	112
	I D	5	3	4	2	4	5	6	9	38
	Total	16	17	16	19	17	14	27	24	150
Encephalocele and other Central Nervous Malformations	S B	—	—	1	1	—	—	—	3	5
	I D	3	1	3	3	4	2	3	1	20
	Total	3	1	4	4	4	2	3	4	25
All Central Nervous Malformations	S B	77	64	72	85	77	61	79	69	584
	I D	45	31	55	44	46	38	45	42	346
	Total	122	95	127	129	123	99	124	111	930
Total Live Births		15,882	14,063	17 657	19,376	21,720	19,185	22 134	24,000	154,017
Total Stillbirths (all Causes)		542	445	543	535	565	500	583	577	4 290
All Births, Live and Still		16,424	14,508	18,200	19,911	22 285	19,685	22,717	24,577	158,307

TABLE XIV

ANNUAL INCIDENCE OF MALFORMATIONS OF THE CENTRAL NERVOUS SYSTEM IN BIRMINGHAM, 1940–1947 (RATE PER 1,000 TOTAL BIRTHS)

Type of Malformation		Year								Whole Period
		1940	1941	1942	1943	1944	1945	1946	1947	
Anencephalus		2 923	2 688	2 637	2 662	2 154	2 286	1 849	1 750	2 312
Spina bifida		3 349	2 619	3 242	2 662	2 423	1 930	2 289	1 628	2 457
Hydrocephalus		0 974	1 172	0 879	0 954	0 763	0 711	1 189	0 977	0 948
Others		0 183	0 069	0 220	0 201	0 179	0 102	0 132	0 163	0 158
All Central Nervous Malformations	Stillbirths	4 688	4 411	3 956	4 269	3 455	3 099	3 477	2 807	3 689
	Infant Deaths	2 740	2 137	3 022	2 210	2 064	1 930	1 981	1 709	2 186
	Total	7 428	6 548	6 978	6 479	5 519	5 029	5 458	4 516	5 875
Stillbirth Rate (all Causes)		33 00	30 67	29 84	26 87	25 35	25 40	25 66	23 48	27 10

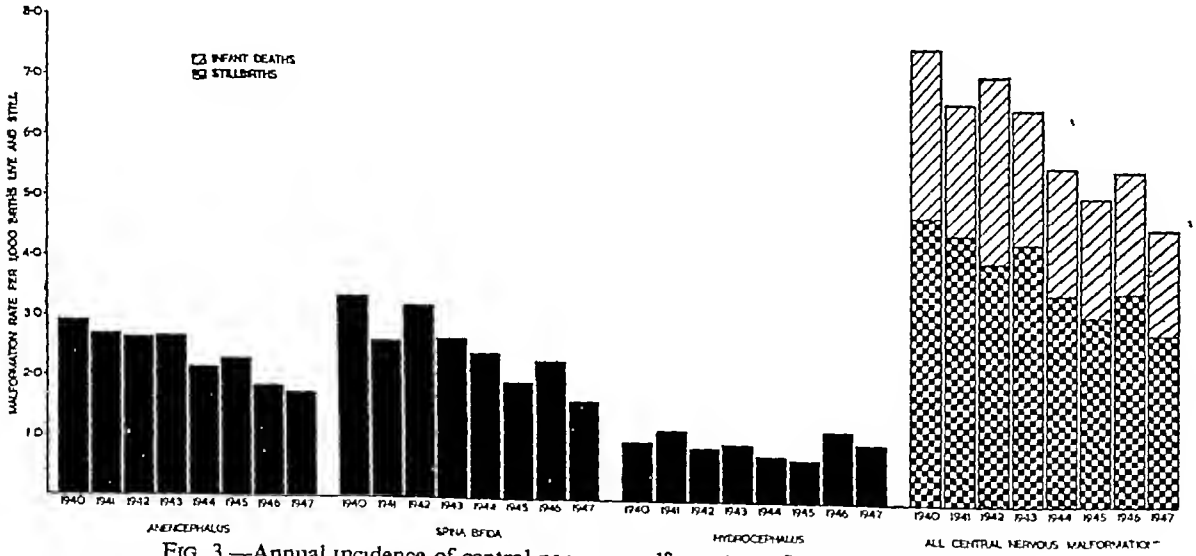

FIG 3.—Annual incidence of central nervous malformations (Birmingham, 1940-47)

parity, since we show below that the risk of a central nervous malformation is relatively greater at the first birth rank and above the sixth. Unfortunately, information on parity is not available for all Birmingham births of these years, and although the data were recorded by field enquiry for a control group selected from all births, the fact that the percentage of women not interviewed varied from year to year considerably reduces its value. We have therefore estimated the proportions of malformations of the central nervous system notified in each year (1941 to 1947)* which are in the first birth rank or above the sixth (Table XV, overleaf). Fig 4 (overleaf) shows that, with the exception of the year 1944, the proportions in the parities where the risks are greatest declined, as did the central nervous malformation rate. We may interpret these observations conservatively by concluding that if the risk at different birth ranks was relatively constant, the observed reduction in the malformation rate could be explained by the changes in the parity of the mothers, and may not indicate a true reduction of the risk in the later years.

THE MALFORMATION AND CONTROL GROUPS COMPARED†

The statistics so far quoted for 930 consecutive malformations of the nervous system were available in central records, and are in consequence free from sampling errors. As indicated in the introduction, additional information in respect of the malformations, and of a control group of normal births, was

* Data for 1940 were incomplete.

† Data from field enquiry.

TABLE XV

ANNUAL PROPORTIONS OF CENTRAL NERVOUS MALFORMATIONS AT THE FIRST OR ABOVE THE SIXTH BIRTH RANKS IN BIRMINGHAM (1941–1947)

	Year							Whole Period
	1941	1942	1943	1944	1945	1946	1947	
Total Malformations	95	127	129	123	99	124	111	808
Malformations of unknown Birth Rank	1	2	1	4	—	—	—	8
Malformations of known Birth Rank	94	125	128	119	99	124	111	800
Number of Birth Rank 1	50	69	56	58	40	53	44	370
Number of Birth Rank 7 and over	5	11	7	5	2	7	4	41
Total of Birth Ranks 1 and 7+	55	80	63	63	42	60	48	411
Percentage of Malformations of Birth Ranks 1 and 7+	58 5	64 0	49 2	52 9	42 4	48 4	43 2	51 4

TABLE XVI

PARTICULARS OF CONTROL SERIES SELECTED FROM REGISTERS OF LIVE BIRTHS AND STILLBIRTHS IN BIRMINGHAM (1940–1947)

	Maternities	Pairs of Twins	Infants Born
Live Births	860	16	876
Stillbirths	22	—	22
Total Live and Stillbirths	882	16	898
Less Central Nervous Malformations	6	—	6
Total	876	16	892

TABLE XVII

WARD GROUP DISTRIBUTION OF ALL INFANTS IN THE CONTROL SERIES COMPARED WITH ALL INFANTS BORN IN BIRMINGHAM (1940–1947)

Ward Group	Infants in Control Series		All Infants born in City	
	Number in Group	Percentage in Group	Number in Group	Percentage in Group
I	322	35 86	56,669	35 80
II	397	44 21	72,006	45 48
III	179	19 93	29,583	18 69
Not located	—	—	49	0 03
Total	898	100	158,307	100

obtained in all cases where the mother could be interviewed, and we now examine the validity of the samples on which the fuller record was completed The selection of every two-hundredth name in the register of live and stillbirths for the years 1940-1947 gave a control group of 898 births, divided in Table XVI into live and stillborn, and single and multiple births This sample is compared with all births in the city for the same years and shows reasonable agreement in respect of ward group* (Table XVII), year of birth (Table XVIII, opposite), and season of birth (Table XIX, p 196) Two adjustments are necessary and when made in Table XVI give 876 mothers in the control group for comparison with 930 in the malformation series

* For discussion of the division of Birmingham city wards into three social groups see Appendix A

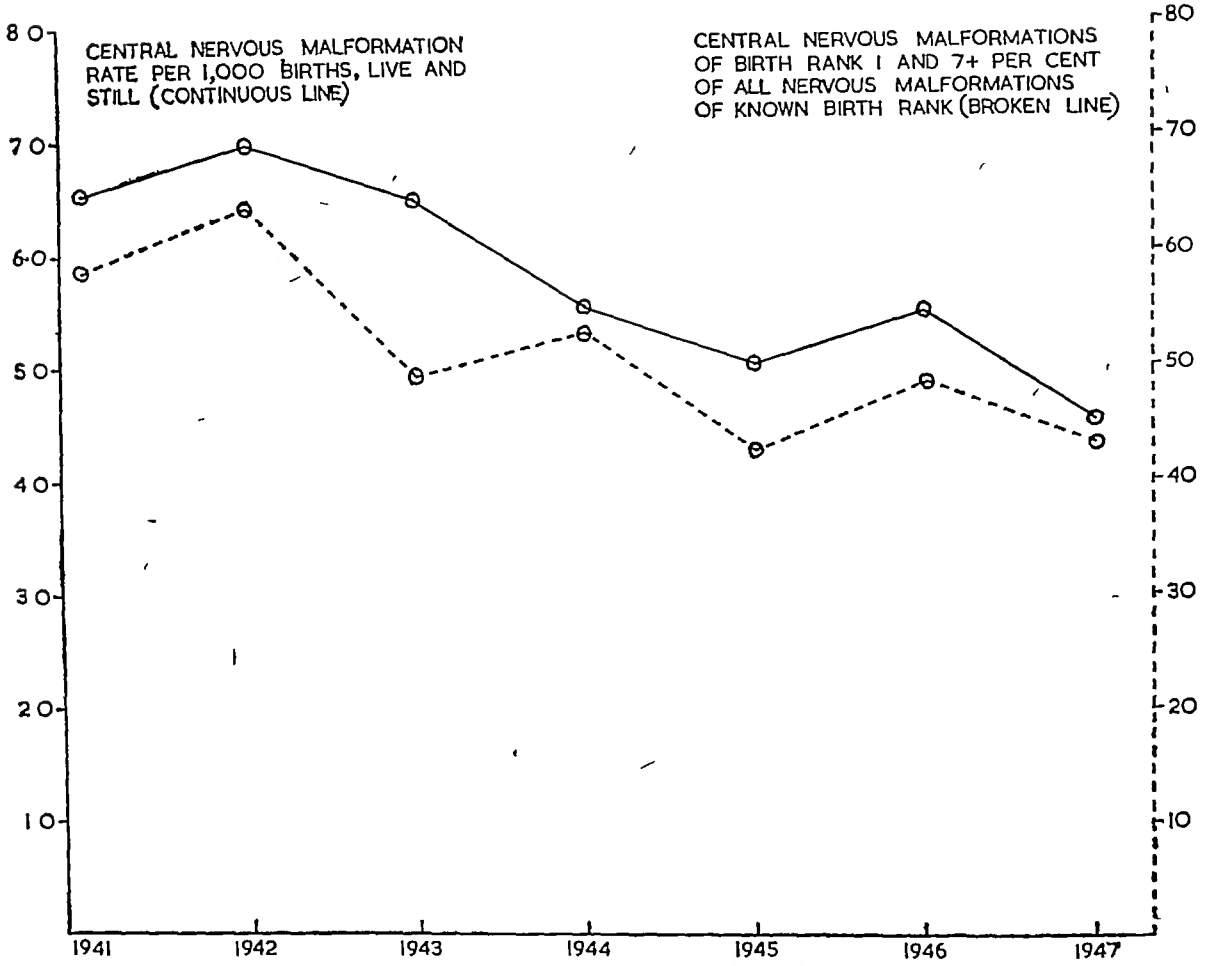

FIG 4—Central nervous malformations annual rates and proportions at birth ranks 1 and 7+ (Birmingham, 1940-47)

TABLE XVIII

ANNUAL DISTRIBUTION OF ALL INFANTS IN THE CONTROL SERIES COMPARED WITH ALL INFANTS BORN IN BIRMINGHAM (1940–1947)

Year	Infants in Control Series		All Infants born in City	
	Number	Percentage	Number	Percentage
1940	99	11 02	16,424	10 37
1941	94	10 47	14,508	9 16
1942	105	11 69	18,200	11 50
1943	113	12 58	19,911	12 58
1944	129	14 37	22,285	14 08
1945	110	12 25	19,685	12 43
1946	116	12 92	22,717	14 35
1947	132	14 70	24,577	15 52
Total	898	100	158,307	99 99

TABLE XIX

QUARTERLY DISTRIBUTION OF ALL INFANTS IN THE CONTROL SERIES COMPARED WITH ALL INFANTS BORN IN BIRMINGHAM (1940–1947)

Quarter	Infants in Control Series		All Infants born in City	
	Number	Percentage	Number	Percentage
January–March	215	23 94	39,383	24 88
April–June	231	25 72	41,036	25 92
July–September	228	25 39	39,017	24 65
October–December	224	24 94	38,871	24 55
Total	898	99 99	158,307	100

TABLE XX

RESULT OF FIELD SURVEY OF MOTHERS OF MALFORMATIONS AND CONTROLS

Result	Malformations		Controls	
	Number	Percentage	Number	Percentage
Not traced	91	9 78	63	7 19
Left Birmingham	57	6 13	55	6 28
Information refused	17	1 83	11	1 26
Died	8	0 86	4	0 46
Mental defective	1	0 11	1	0 11
Information unreliable	1	0 11	—	—
Not interviewed	175	18 82±1 28	134	15 30±1 22
Successfully interviewed	755	81 18	742	84 70
Total abstracted	930	100	876	100

TABLE XXI (see also Fig. 5)

PERCENTAGE OF MALFORMATIONS AND CONTROLS INTERVIEWED IN EACH YEAR AND WARD GROUP

	Ward Group	1940	1941	1942	1943	1944	1945	1946	1947	Total
I	Malformations	48	75	79	75	81	74	86	92	76 4
	Controls	62	81	91	84	93	86	75	93	83 5
II	Malformations	80	86	84	85	81	86	89	93	85 3
	Controls	84	86	84	85	85	81	94	96	87 1
III	Malformations	68	67	77	82	87	71	93	100	80 8
	Controls	89	65	71	83	75	70	96	100	81 4
All	Malformations	65	79	81	81	82	79	89	94	81 2
	Controls	76	79	84	84	85	81	88	95	84 7

(1) The malformations are compared with births not resulting in a central nervous malformation (not with all births), thus six malformations are excluded

(2) The analysis is based on the number of maternities, and not on the number of births

Successful interviews were completed in fewer malformations (81 per cent) than controls (85 per cent), a difference unlikely to be due to chance (Table XX) The data given by year and ward group in Table XXI (and Fig 5, opposite),

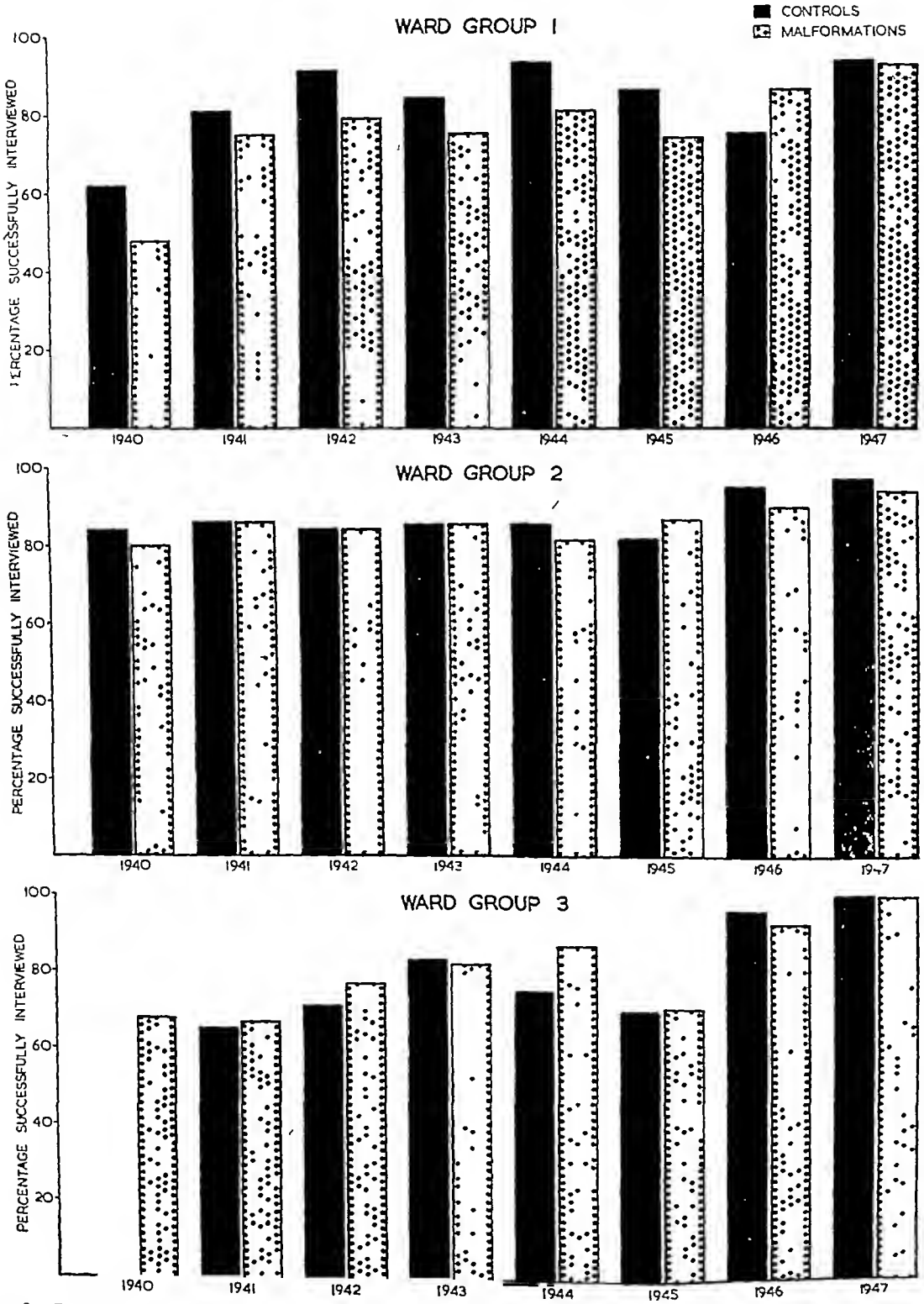

FIG 5.—Percentage of malformations and controls interviewed in each year and ward group (see also Table XXI)

TABLE XXII (see also Fig 6)

COMPARISON BETWEEN MOTHERS OF MALFORMATIONS INTERVIEWED AND NOT INTERVIEWED IN RESPECT OF AGE AND PARITY

	Interviewed		Not Interviewed	
	Number	Percentage	Number	Percentage
Maternal Age Group				
17–21	73	9 7	29	20 6
22–26	229	30 3	46	32 6
27–31	184	24 4	31	22 0
32–36	157	20 8	23	16 3
37–41	88	11 7	11	7 8
42–46	24	3 2	1	0 7
Total	755	100 1	141	100 0
Maternal Age not known	—	—	34	—
Birth Rank				
1	334	44 2	89	56 7
2 and 3	264	35 0	52	33 1
4, 5, and 6	109	14 4	14	8 9
7+	48	6 4	2	1 3
Total	755	100 0	157	100 0
Birth Rank not known	—	—	18	—

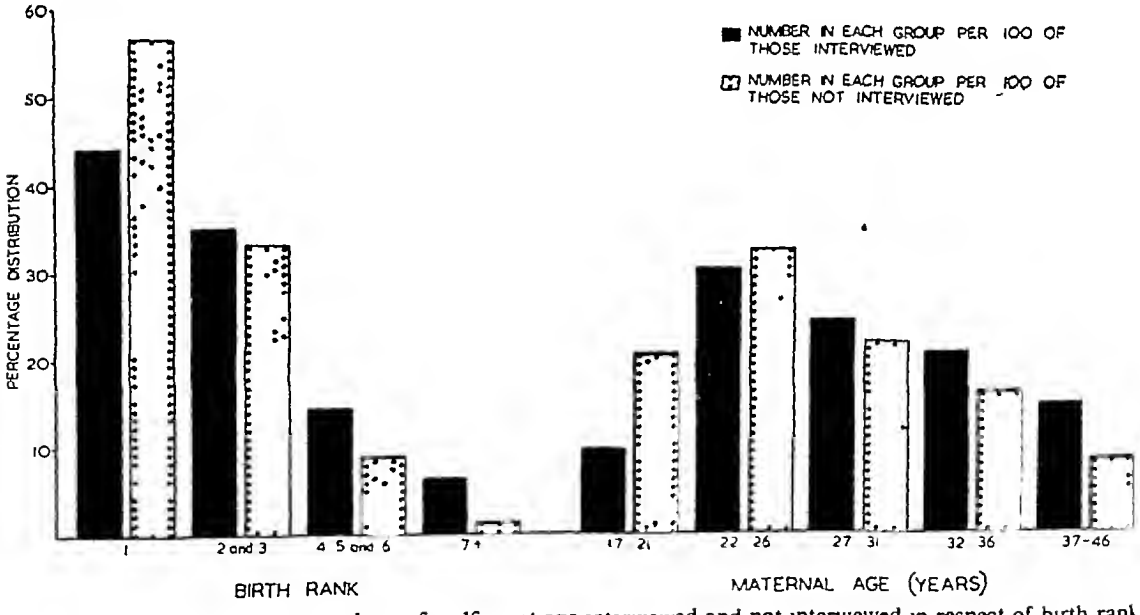

FIG 6—Comparison between mothers of malformations interviewed and not interviewed in respect of birth rank and maternal age

show that the main discrepancy occurred in 1940 in ward groups I and III In ward group I (the lowest social group) the proportion of malformations interviewed was consistently lower in the years 1940 to 1945 In most cases where mothers were not interviewed details of age and parity were available from central records, and are compared in Table XXII with the sample (Fig 6)

TABLE XXIII

SUCCESSFULLY TRACED CENTRAL NERVOUS MALFORMATIONS CLASSIFIED ACCORDING TO TYPE

Simplified Classification	Full Classification		Number Traced	Percentage of Number Notified
Anencephalus	alone	280	305	83 3
	with spina bifida	25		
Spina bifida	alone	204	309	79 4
	with hydrocephalus	101		
	with encephalocele	3		
	with hydrocephalus and encephalocele	1		
Hydrocephalus	alone	118	118	78 7
Others	encephalocele	11	23	92 0
	other central nervous malformations	12		
Total		755	755	81 2

TABLE XXIV (see also Fig 7)

NUMBERS OF MALFORMATIONS AND CONTROLS AT DIFFERENT BIRTH RANKS AND MATERNAL AGE GROUPS

Maternal Age Group	Birth Rank						Total	Percentage Distribution by Maternal Age
	1	2	3	4	5 and 6	7+		
Malformations								
17–21	66	7	—	—	—	—	73	9 669
22–26	142	51	25	7	4	—	229	30 331
27–31	72	57	31	12	11	1	184	24 371
32–36	43	45	25	16	19	9	157	20 795
37–41	10	13	9	14	18	24	88	11 656
42–46	1	—	1	4	4	14	24	3 179
Total	334	173	91	53	56	48	755	
Percentage distribution by birth rank	44 238	22 914	12 053	7 020	7 417	6 358		100 00
Controls								
17–21	56	9	2	—	—	—	67	9 030
22–26	107	73	29	11	2	—	222	29 919
27–31	62	78	37	17	12	—	206	27 763
32–36	20	47	32	26	24	8	157	21 159
37–41	7	12	8	14	19	9	69	9 299
42–46	—	2	3	6	4	6	21	2 830
Total	252	221	111	74	61	23	742	
Percentage distribution by birth rank	33 962	29 784	14 960	9 973	8 221	3 100		100 00

The proportion of first births, and of low maternal ages, is higher for untraced births, and may be explained by the greater mobility of small families Malformations of the central nervous system are more common in first than in later births (see below), and this fact may account for the higher proportion untraced Table XXIII gives the proportion of successful interviews for different malformations

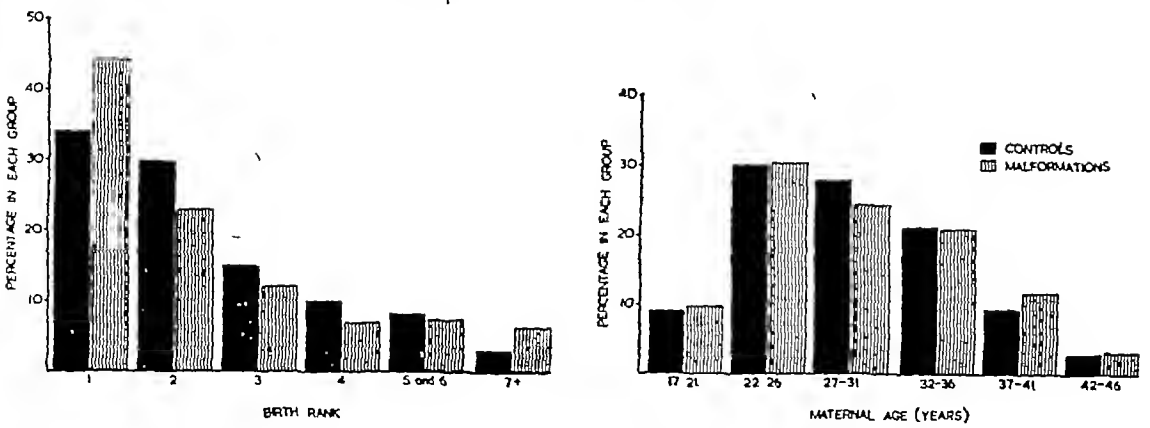

FIG 7.—Percentage distribution of malformations and controls at different maternal ages and birth ranks

TABLE XXV

NUMBERS OF MALFORMATIONS AT DIFFERENT BIRTH RANKS AND MATERNAL AGES

Maternal Age (years)	Birth Rank														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
17	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2
18	3	—	—	—	—	—	—	—	—	—	—	—	—	—	3
19	11	1	—	—	—	—	—	—	—	—	—	—	—	—	12
20	24	2	—	—	—	—	—	—	—	—	—	—	—	—	26
21	26	4	—	—	—	—	—	—	—	—	—	—	—	—	30
22	40	6	2	—	—	—	—	—	—	—	—	—	—	—	48
23	21	7	1	2	—	—	—	—	—	—	—	—	—	—	31
24	29	13	4	—	—	—	—	—	—	—	—	—	—	—	46
25	22	14	11	1	2	—	—	—	—	—	—	—	—	—	50
26	30	11	7	4	2	—	—	—	—	—	—	—	—	—	54
27	17	10	7	—	1	1	1	—	—	—	—	—	—	—	37
28	21	9	10	4	—	2	—	—	—	—	—	—	—	—	46
29	14	12	6	2	—	—	—	—	—	—	—	—	—	—	34
30	12	14	3	3	1	1	—	—	—	—	—	—	—	—	34
31	8	12	5	3	3	2	—	—	—	—	—	—	—	—	33
32	21	14	7	6	2	1	—	—	1	—	—	—	—	—	52
33	9	12	—	3	3	—	—	—	1	—	—	—	—	—	28
34	8	4	6	—	5	1	—	2	3	1	—	—	—	—	30
35	2	8	4	3	1	2	1	—	—	—	—	—	—	—	21
36	3	7	8	4	3	1	—	—	—	—	—	—	—	—	26
37	—	—	2	3	5	—	1	1	2	—	—	—	—	—	14
38	5	4	1	5	2	1	2	4	—	1	—	—	—	—	25
39	1	3	3	1	—	3	—	1	1	—	—	—	—	—	13
40	1	3	2	3	1	1	2	2	1	—	—	—	1	1	18
41	3	3	1	2	1	4	1	1	—	1	—	1	—	—	18
42	—	—	1	1	—	1	—	1	—	2	2	—	—	—	8
43	1	—	—	2	1	—	2	1	—	2	—	1	—	—	10
44	—	—	—	1	1	1	—	—	—	—	—	1	—	—	4
45	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
46	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
Total	334	173	91	53	34	22	10	13	9	8	2	3	1	2	755

Maternal Age and Parity

Data Derived from the Survey.—Our examination of the association of maternal age and parity with the risk of a central nervous malformation is based on a comparison between the malformation and control groups. Maternal age was recorded as the age of the mother at the birth of the propositus, and birth rank as one more than the number of all known previous pregnancies (that is, it was determined by the number of pregnancies, and not by the number of live births). Each birth was next allocated to the appropriate cell of a contingency table (Tables XXV and XXVI). Maternal ages and the higher birth ranks have been grouped, and percentage distributions calculated for row and column totals, in Table XXIV (see also Fig. 7). For any age or parity the ratio of the percentage of malformations to the percentage of controls gives a measure of the relative risk of the birth of a malformation, which can be interpreted in relation to an average risk of unity for all ages and parities (Table XXIX and Fig. 8, see p. 204). The figures show that the risk is considerably increased at the first parity and above the sixth, and is correspondingly reduced between these extremes. Variations in association with maternal age are also present, but are less marked.

It is well known that the high correlation between these two variables makes it necessary to separate their effects, and in Table XXVII the risk at different birth ranks is estimated for each five-year maternal age group. The risks noted in association

TABLE XXVI

Numbers of Controls at Different Birth Ranks and Maternal Ages

Maternal Age (years)	Birth Rank																	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
17	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
18	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
19	16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16
20	11	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16
21	23	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	28
22	23	4	6	1	—	—	—	—	—	—	—	—	—	—	—	—	—	34
23	33	19	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	58
24	15	9	3	1	—	—	—	—	—	—	—	—	—	—	—	—	—	28
25	20	21	7	4	—	—	—	—	—	—	—	—	—	—	—	—	—	52
26	16	20	8	4	2	—	—	—	—	—	—	—	—	—	—	—	—	50
27	16	15	3	5	—	—	—	—	—	—	—	—	—	—	—	—	—	39
28	11	18	6	6	2	—	—	—	—	—	—	—	—	—	—	—	—	43
29	19	16	7	2	2	1	—	—	—	—	—	—	—	—	—	—	—	47
30	9	21	12	3	1	3	—	—	—	—	—	—	—	—	—	—	—	49
31	7	8	9	1	3	—	—	—	—	—	—	—	—	—	—	—	—	28
32	6	11	8	6	—	5	2	—	—	—	—	—	—	—	—	—	—	38
33	6	10	8	6	3	1	—	—	—	—	—	—	—	—	—	—	—	34
34	3	7	7	4	2	2	1	1	—	1	—	—	—	—	—	—	—	28
35	3	13	5	5	4	3	1	—	—	—	1	—	—	—	—	—	—	35
36	2	6	4	5	3	1	—	1	—	—	—	—	—	—	—	—	—	22
37	4	3	3	4	7	1	—	—	—	—	—	—	—	—	—	—	—	22
38	2	3	2	4	1	—	2	—	—	—	—	—	—	—	—	—	—	14
39	—	3	—	3	2	1	1	—	—	—	1	—	—	—	—	—	—	11
40	—	3	2	3	—	1	—	1	—	—	—	—	—	—	—	—	—	10
41	1	—	1	—	4	2	2	1	1	—	—	—	—	—	—	—	—	12
42	—	—	2	4	1	—	1	—	—	—	—	—	—	1	—	—	—	9
43	—	—	—	1	—	2	—	—	—	—	—	—	—	—	—	—	—	3
44	—	2	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	4
45	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	2
46	—	—	—	—	—	1	—	—	1	—	1	—	—	—	—	—	—	3
Total	252	221	111	74	37	24	10	4	3	1	3	—	—	1	—	—	1	742

TABLE XXVII

DISTRIBUTION OF MALFORMATIONS AND CONTROLS IN THE SAME MATERNAL AGE GROUPS AT DIFFERENT BIRTH RANKS

Maternal Age Group	Birth Rank	Malformations			Controls			Difference between percentages	Standard error of difference
		No	%	S.E.	No	%	S E.		
17–21	1	66	90 411	3 45	56	83 582	4 53	+ 6 83	5 69
	2	7	9 589	3 45	9	13 433	4 16	− 3 84	5 41
	3	—	—	—	2	2 985	2 08	− 2 99	2 08
	All ranks	73	100 00	—	67	100 00	—		
22–26	1	142	62 009	3 21	107	48 198	3 35	+13 81*	4 64
	2	51	22 271	2 75	73	32 883	3 15	−10 61*	4 18
	3	25	10 917	2 06	29	13 063	2 26	− 2 15*	3 06
	4	7	3 057	1 44	11	4 955	1 46	− 1 90	1 85
	5 and 6	4	1 747	0 87	2	0 901	0 63	+ 0 85	1 07
	All ranks	229	100 00	—	222	100 00	—		
27–31	1	72	39 130	3 60	62	30 097	3 20	+ 9 03	4 81
	2	57	30 978	3 41	78	37 864	3 38	− 6 89	4 80
	3	31	16 848	2 76	37	17 961	2 67	− 1 11	3 84
	4	12	6 522	1 82	17	8 252	1 92	− 1 73	2 64
	5 and 6	11	5 978	1 75	12	5 825	1 63	+ 0 15	2 39
	7+	1	0 543	0 54	—	—	—	+ 0 54	0 54
	All ranks	184	100 00	—	206	100 00	—		
32–36	1	43	27 389	3 56	20	12 739	2 66	+14 65*	4 44
	2	45	28 662	3 61	47	29 936	3 65	− 1 27	5 14
	3	25	15 924	2 92	32	20 382	3 21	− 4 46	4 34
	4	16	10 191	2 41	26	16 561	2 97	− 6 37	3 82
	5 and 6	19	12 102	2 60	24	15 287	2 87	− 3 18	3 88
	7+	9	5 732	1 86	8	5 096	1 75	+ 0 64	2 55
	All ranks	157	100 00	—	157	100 00	—		
37–41	1	10	11 364	3 38	7	10 145	3 63	+ 1 22	4 97
	2	13	14 773	3 78	12	17 391	4 56	− 2 62	5 93
	3	9	10 227	3 23	8	11 594	3 85	− 1 37	5 03
	4	14	15 909	3 90	14	20 290	4 84	− 4 38	6 22
	5 and 6	18	20 455	4 30	19	27 536	5 38	− 7 08	6 89
	7+	24	27 273	4 75	9	13 043	4 05	+14 23*	6 24
	All ranks	88	100 00	—	69	100 00	—		
42–46	1	1	4 167	4 08	—	—	—	+ 4 17	4 08
	2	—	—	—	2	9 524	6 40	− 9 52	6 40
	3	1	4 167	4 08	3	14 286	7 64	−10 12	8 66
	4	4	16 667	7 61	6	28 571	9 86	−11 90	12 45
	5 and 6	4	16 667	7 61	4	19 048	8 57	− 2 38	11 46
	7+	14	58 333	10 06	6	28 571	9 86	+29 76*	14 09
	All ranks	24	100 00	—	21	100 00	—		
All ages	1	334	44 238	1 81	252	33 962	1 74	+10 28*	2 51
	2	173	22 914	1 53	221	29 784	1 68	− 6 87*	2 27
	3	91	12 053	1 18	111	14 960	1 31	− 2 91	1 77
	4	53	7 020	0 93	74	9 973	1 10	− 2 95*	1 44
	5 and 6	56	7 417	0 95	61	8 221	1 01	− 0 80	1 39
	7+	48	6 358	0 89	23	3 100	0 64	+ 3 26*	1 09
Total all ranks		755	100 00	—	742	100 00	—		

* Difference exceeds twice its standard error

TABLE XXVIII

DISTRIBUTION OF MALFORMATIONS AND CONTROLS IN THE SAME BIRTH RANKS AT DIFFERENT MATERNAL AGE GROUPS

Birth Rank	Maternal Age Group	Malformations			Controls			Difference between percentages	Standard error of difference
		No	%	S E	No	%	S E		
1	17–21	66	19 760	2 18	56	22 222	2 62	− 2 46	3 41
	22–26	142	42 515	2 70	107	42 460	3 11	+ 0 06	4 12
	27–31	72	21 557	2 25	62	24 603	2 71	− 3 05	3 52
	32–36	43	12 874	1 83	20	7 937	1 70	+ 4 94	2 50
	37–41	10	2 994	0 93	7	2 778	1 03	+ 0 22	1 39
	42–46	1	0 299	0 30	—	—	—	+ 0 30	0 30
	All groups	334	100 00	—	252	100 00	—		
2	17–21	7	4 046	1 50	9	4 072	1 33	− 0 03	2 00
	22–26	51	29 480	3 47	73	33 032	3 16	− 3 55	4 69
	27–31	57	32 948	3 57	78	35 294	3 21	− 2 35	4 81
	32–36	45	26 012	3 34	47	21 267	2 75	+ 4 74	4 32
	37–41	13	7 514	2 00	12	5 430	1 52	+ 2 08	2 52
	42–46	—	—	—	2	0 905	0 64	− 0 90	0 64
	All groups	173	100 00	—	221	100 00	—		
3	17–21	—	—	—	2	1 802	1 26	− 1 80	1·26
	22–26	25	27 473	4 68	29	26 126	4 17	+ 1 35	6 27
	27–31	31	34 066	4 97	37	33 333	4 47	+ 0 73	6 69
	32–36	25	27 473	4 68	32	28 829	4 30	− 1 36	6 35
	37–41	9	9 890	3 13	8	7 207	2 45	+ 2 68	3 98
	42–46	1	1 099	1 09	3	2 703	1 54	− 1 60	1 89
	All groups	91	100 00	—	111	100 00	—		
4	22–26	7	13 208	4 65	11	14 865	4 14	− 1 66	6 22
	27–31	12	22 642	5 75	17	22 973	4 89	− 0 33	7 55
	32–36	16	30 189	6 31	26	35 135	5 55	− 4 95	8 40
	37–41	14	26 415	6 06	14	18 919	4 55	+ 7 50	7 58
	42–46	4	7 547	3 63	6	8 108	3 17	− 0 56	4 82
	All groups	53	100 00	—	74	100 00	—		
5 and 6	22–26	4	7 143	3 44	2	3 279	2 28	+ 3 86	4 13
	27–31	11	19 643	5 32	12	19 672	5 09	− 0 03	7 35
	32–36	19	33 928	6 33	24	39 344	6 25	− 5 42	8 90
	37–41	18	32 143	6 24	19	31 148	5 93	+ 0 99	8 61
	42–46	4	7 143	3 44	4	6 557	3 17	+ 0 59	4 68
	All groups	56	100 00	—	61	100 00	—		
7+	27–31	1	2 083	2 06	—	—	—	+ 2 08	2 06
	32–36	9	18 750	5 63	8	34 783	9 93	−16 03	11 42
	37–41	24	50 000	7 22	9	39 130	10 17	+10 87	12 48
	42–46	14	29 167	6 56	6	26 087	9 16	+ 3 08	11 26
	All groups	48	100 00	—	23	100 00	—		
All birth ranks	17–21	73	9 669	1 07	67	9 030	1 05	+ 0 64	1 50
	22–26	229	30 331	1 67	222	29 919	1 68	+ 0 41	2 37
	27–31	184	24 371	1 56	206	27 763	1 64	− 3 39	2 27
	32–36	157	20 795	1 48	157	21 159	1 50	− 0 36	2 10
	37–41	88	11 656	1 17	69	9 299	1 07	+ 2 36	1 58
	42–46	24	3 179	0 64	21	2 830	0 61	+ 0 35	0 88
Total all groups		755	100 00	—	742	100 00	—		

TABLE XXIX (see also Fig. 8)

PERCENTAGE DISTRIBUTION OF MALFORMATIONS AND CONTROLS AT DIFFERENT BIRTH RANKS AND MATERNAL AGE GROUPS

	Distribution				Relative Risk of a Malformation
	Malformations		Controls		
	Number	Percentage	Number	Percentage	
Birth Rank					
1	334	44 24	252	33 96	1 30
2	173	22 91	221	29 78	0 77
3	91	12 05	111	14 96	0 81
4	53	7 02	74	9 97	0 70
5 and 6	56	7 42	61	8 22	0 90
7+	48	6 36	23	3 10	2 05
All birth ranks	755	100 00	742	99 99	1 00
Maternal Age Group					
17–21	73	9 67	67	9 03	1 07
22–26	229	30 33	222	29 92	1 01
27–31	184	24 37	206	27 76	0 88
32–36	157	20 79	157	21 16	0 98
37–41	88	11 66	69	9 30	1 25
42–46	24	3 18	21	2 83	1 12
All age groups	755	100 00	742	100 00	1 00

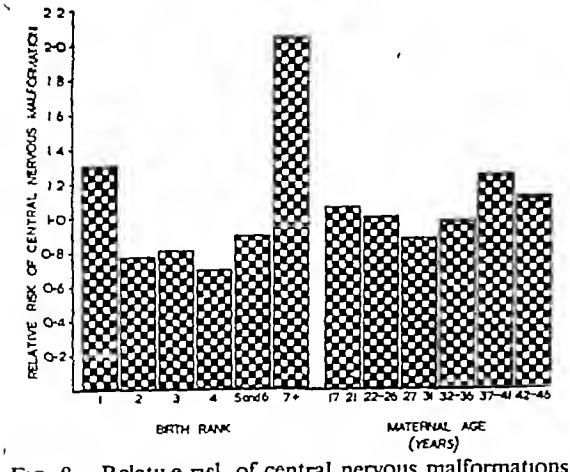

FIG 8.—Relative risk of central nervous malformations at different birth ranks and maternal ages

with parity for the whole series are fairly consistently reflected in the more detailed figures, although in some groups the numbers are small. It will be recalled that interviews were not completed for a higher proportion of mothers in the malformation series, and since first births were more common among mothers not traced, the effect of primiparity is likely to be somewhat greater than that indicated by the figures.

In Table XXVIII the same procedure is adopted in the examination of the effect of maternal age at different birth ranks; the figures demonstrate no consistent association between maternal age and the incidence of malformations, when birth rank is kept constant. Our data also enable us to examine the association of age and parity with the different types of central nervous malformation included in this study (Table XXX and Figs. 9 and 10, opposite), although the smaller numbers do not permit a separation of their effects. For anencephalus and spina bifida the results are similar to those already quoted for the whole series, but for hydrocephalus the effect of birth rank is slight when compared with the marked effect of high maternal age.

Before accepting these conclusions it is necessary to consider two possible criticisms of the validity of the method on which they are based. In the first place, if malformations were more common in families of low fertility, or if the birth of a malformation often induced parents to avoid further pregnancies, a disproportionate number of malformations would be expected in the lower birth ranks, and especially in the first birth rank. Table XXXI and Fig. 11 (p. 206) show that the malformation and control groups are reasonably comparable in respect of the mean number of pregnancies. Indeed, the figure is slightly higher for the malformations,

TABLE XXX

MALFORMATIONS OF DIFFERENT TYPES DISTRIBUTED BY BIRTH RANK AND MATERNAL AGE GROUP

		Birth Rank				Maternal Age Group			
		1	2–6	7+	Total	17–26	27–36	37–46	Total
Controls	Number	252	467	23	742	289	363	90	742
	Percentage	33 962	62 938	3 100	100	38 949	48 922	12 129	100
	Standard error	1 74	1 77	0 64		1 79	1 83	1 20	
Anencephalus	Number	142	146	17	305	126	139	40	305
	Percentage	46 557	47 869	5 574	100	41 311	45 574	13 115	100
	Standard error	2 86	2 86	1 31		2 82	2 85	1 93	
	Difference from Control	+12 59*	−15 07*	+2 47		+2 36	−3 35	+0 99	
		±3 34	±3 36	±1 46		±3 34	±3 39	±2 27	
Spina bifida	Number	140	148	21	309	130	133	46	309
	Percentage	45 307	47 897	6 796	100	42 071	43 042	14 887	100
	Standard error	2 83	2 84	1 43		2 81	2 82	2 02	
	Difference from Control	+11 34*	−15 04	+3 70		+3 12	−5 88	+2 76	
		±3 32	±3 35	±1 57		±3 33	±3 36	±2 35	
Hydrocephalus	Number	43	66	9	118	36	57	25	118
	Percentage	36 441	55 932	7 627	100	30 508	48 305	21 186	100
	Standard error	4 43	4 57	2 44		4 24	4 60	3 76	
	Difference from Control	+2 48	−7 01	+4 53		−8 44	−0 62	+9 06	
		±4 76	±4 90	±2 53		±4 60	±4 95	±3 95	

* Difference exceeds twice its standard error

an observation which may be explained by the reduction in the period of physiological infertility resulting from the higher incidence of abortions Secondly, incidence of first births and of malformations was higher in the earlier years of the eight-year period from which this series is drawn Since controls were selected as a constant proportion of all births in each year, it is possible that the sample is weighted in respect of parity against the controls Table XXXIII (p 207) gives the percentages of births in different birth ranks by year, and indicates that in all years except 1940 the proportions of propositi of first birth ranks and above the sixth are consistently higher in the malformation series The exception in 1940 is explained by the high incidence of untraced first births in the malformations

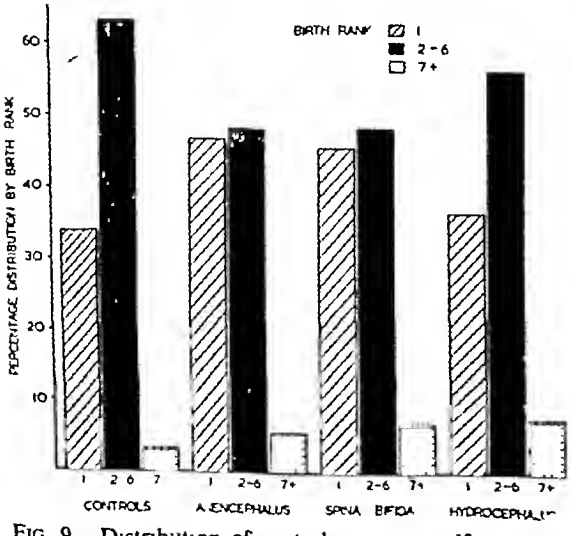

FIG 9—Distribution of central nervous malformations by birth rank

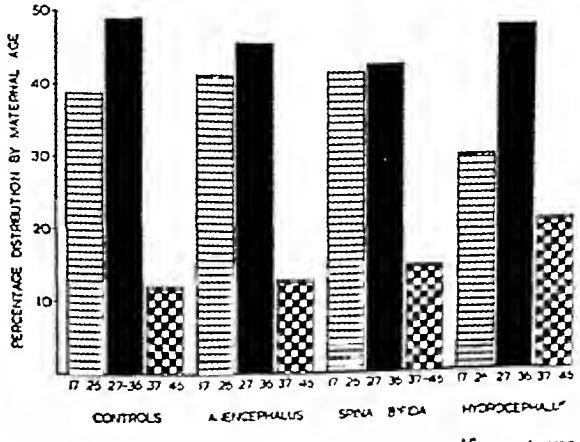

FIG 10—Distribution of central nervous malformations by maternal age

TABLE XXXI

MOTHERS OF THE MALFORMATION AND CONTROL BIRTHS COMPARED IN RESPECT OF THE NUMBER OF PREGNANCIES

Number of Pregnancies	Malformations Group		Control Group	
	Number	Per-centage	Number	Per-centage
1	130	17 22	147	19 81
2	208	27 55	232	31 27
3	172	22 78	146	19 68
4	95	12 58	96	12 94
5	54	7 15	57	7 68
6	36	4 77	30	4 04
7	13	1 72	11	1 48
8	13	1 72	11	1 48
9	9	1 19	4	0 54
10	11	1 46	—	—
11	5	0 66	5	0 67
12	4	0 53	1	0 13
13	3	0 40	—	—
14	2	0 26	1	0 13
15	—	—	—	—
16	—	—	—	—
17	—	—	1	0 13
Total	755	100 0	742	100 0
Mean number of pregnancies	3 29 (S D 2 27)		2 96 (S D 1 92)	
Difference	0 33±0 11			

TABLE XXXII

STILLBIRTHS WITH ANENCEPHALUS DISTRIBUTED BY MATERNAL AGE GROUP AND BIRTH RANK IN SCOTLAND (1939–1945)

Distribution	Number of Births	Stillbirths due to anencephalus	Stillbirth rate due to anencephalus
Maternal Age Group			
<20	28,593		
20–24	155,520	73	2 553
25–29	182,238	359	2 308
30–34	146,609	439	2 409
35–39	87,683	405	2 762
40+	28,301	302	3 444
Not stated	2,325	93	3 286
		1	—
Total	631,269	1,672	2 649
Birth Rank			
1	221,943	558	2 514
2	143,031	313	2 188
3	82,286	227	2 759
4	49,390	157	3 179
5 & 6	51,671	181	3 503
7+	37,728	136	3 605
Not stated	11	—	—
Total	586,060	1,572	2 682

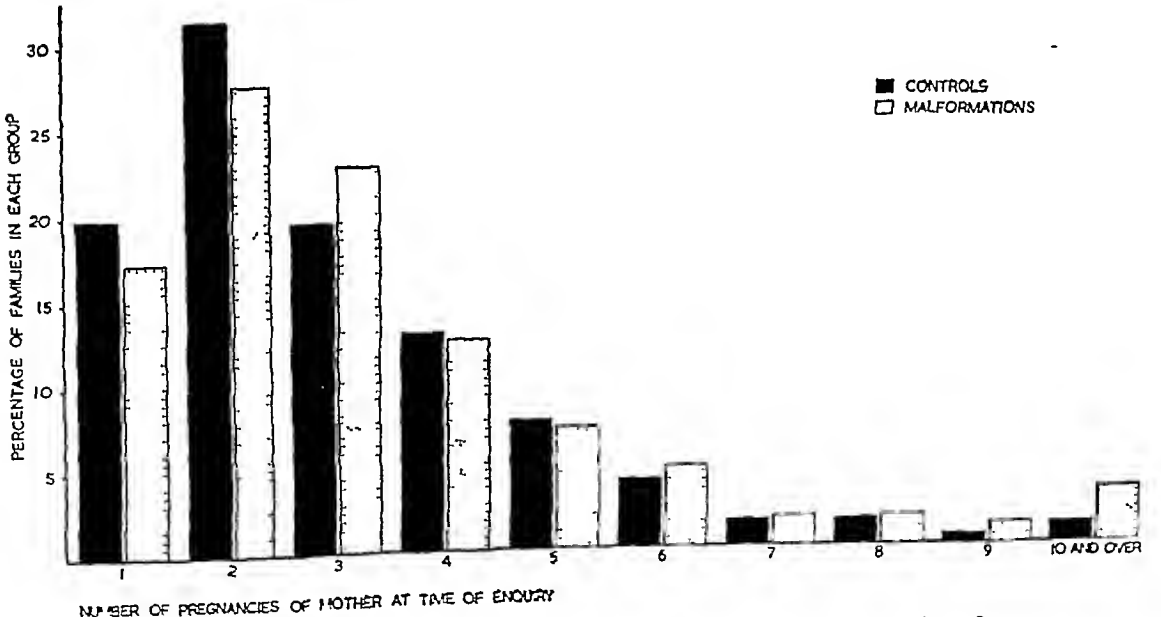

FIG 11.—Mothers of malformations and control births compared in respect of the number of pregnancies

TABLE XXXIII

PERCENTAGE DISTRIBUTION OF PROPOSITI BY BIRTH RANK FOR EACH YEAR

Birth Rank	Year								All Years
	1940	1941	1942	1943	1944	1945	1946	1947	
Malformations									
1	23 8	42 1	41 7	37 2	39 0	29 3	37 1	36 9	35 9
2 and 3	24 6	17 9	24 4	29 5	29 3	35 4	28 2	37 8	28 4
4, 5 and 6	9 8	13 7	7 1	9 3	9 8	12 1	17 7	15 3	11 7
7+	6 6	5 3	7 9	5 4	4 1	2 0	5 6	3 6	5 2
Not found	35 2	21 1	18 9	18 6	17 9	21 2	11 3	6 3	18 8
Total	100	100	100	100	100	100	100	100	100 0
Controls									
1	29 2	31 9	36 9	33 0	23 4	21 3	25 4	30 5	28 8
2 and 3	27 1	25 3	32 0	36 7	42 7	41 7	43 9	47 3	37 9
4, 5 and 6	15 6	16 5	14 6	12 8	17 7	15 7	14 0	16 0	15 4
7+	4 2	5 5	1 0	1 8	1 6	1 9	4 4	1 5	2 6
Not found	24 0	20 9	15 5	15 6	14 5	19 4	12 3	4 6	15 3
Total	100	100	100	100	100	100	100	100	100 0
Percentages of Birth Ranks 1 and 7+									
In malformation series	30 4	47 4	49 6	42 6	43 1	31 3	42 7	40 5	41 1
In control series	33 4	37 4	37 9	34 8	25 0	23 2	29 8	32 0	31 4
Difference	−3 0	10 0	11 7	7 8	18 1	8 1	12 9	8 5	9 7

DATA DERIVED FROM THE REPORTS OF THE REGISTRAR-GENERAL FOR SCOTLAND (1939-1945) — The reports of the Registrar-General for Scotland since 1939 give for stillbirths the age of the mother and the number of previous children The same information is not provided for infant deaths, and the effects of age and parity can only be examined for anencephalus which almost always results in the birth of a stillborn foetus The figures given in Table XXXII (opposite) for the years 1939-1945 show the increased risks observed in the Birmingham data, but relatively the effects at higher ages and parities are much greater (Fig 12) The two sets of data are not strictly comparable, for the Scottish figures are based only on legitimate births, and the Registrar-General neglects abortions in estimating parity The higher incidence of abortions in mothers of malformations is certain to influence birth rank Unfortunately, the Scottish data do not enable us to examine separately the effects of maternal age and parity

DISCUSSION —The relation of maternal age and parity to the incidence of congenital malformations has been considered by several writers, but adequate data on malformations and controls have not been available, and no evidence so far published settles the issue beyond doubt Still (1927) first compared a small number of malformations with an unsatisfactory control group, and concluded that risks were higher with first born, particularly in the case

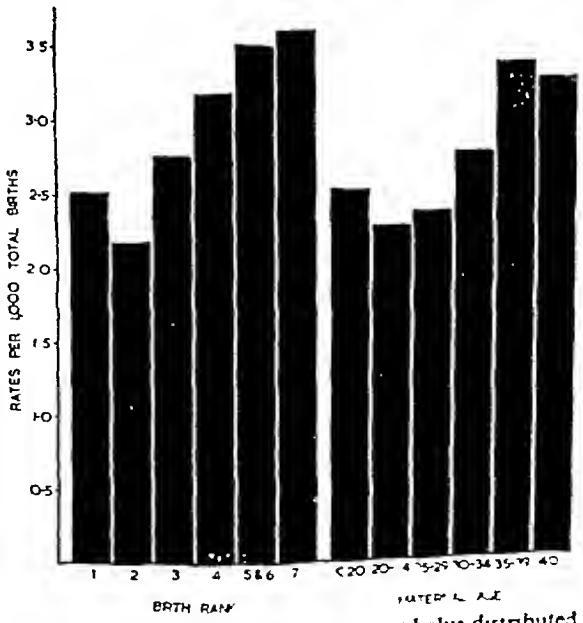

FIG 12.—Stillbirth rates due to anencephalus distributed by birth rank and maternal age (Scotland 1939-45)

of pyloric stenosis In the case of mongolism, however, the risk appeared to be greater at high maternal age , His results were criticized by Macklin (1929) who examined statistics on 1,000 malformations collected from the literature, and decided that primogeniture had no effect. Equally unsatisfactory are reports based on hospital records, in which the numbers are small and the populations unrepresentative (Malpas, 1937, Potter and Adair, 1943, Drillien, 1947)

Murphy (1940) completed a field study of malformations selected from the register of deaths in Philadelphia, and using the Greenwood-Yule method compared the malformations with the non-malformed children of the same sibships He noted that the risk of birth of a malformation increased with both age and parity, but did not separate the two effects In this series, many of the sibships were incomplete at the time of the investigation which was finished within six years of the first death and less than one year after the last, and the control group was therefore likely to be deficient in the higher birth ranks and maternal ages Data published by Hindse-Nielsen (1938) on 160 cases of spina bifida in 130 families permit an examination of the association with birth rank, which shows that this malformation was slightly less frequent in the first three birth ranks Once again there is no indication that the sibships were complete at the, time the data were recorded

The most useful contribution yet available on this subject was made by Penrose (1934, 1946) In the first of two papers he showed that the risk of mongolism increased with advancing maternal age, the effect of birth rank was less marked, but the first born and infants of high birth rank seemed predisposed to the condition His second paper dealt with 144 malformations of the nervous system, and, using a modification of the Greenwood-Yule method, he found that their incidence increased significantly with advancing maternal age and with rising birth rank The effect of maternal age appeared to be more marked than that of birth rank, although when the influence of maternal age was eliminated, primogeniture still seemed to increase the risk The discrepancy between Penrose's results and our own may be explained by the higher proportion of hydrocephalics in his series (31 per cent compared with 16 per cent) for, as we have shown, the incidence of hydrocephalus is markedly increased at higher maternal ages

Social Status

Indices of social status used are locality of domicile, rent of house, and legitimacy The father's occupation was also recorded, but is not considered sufficiently reliable for analysis

Locality of Domicile —Appendix A describes a classification of the city wards into three social

TABLE XXXIV

Malformations Classified by Ward Groups

Type of Malformation	Ward Group*						Unlocated	All Wards	
	I		II		III				
	No	Rates per 1,000 related Births	No	Rates per 1,000 related Births	No	Rates per 1,000 related Births		No	Rates per 1,000 related Births
Anencephalus	121	2 135	170	2 361	75	2 535	—	366	2 312
Spina bifida	136	2 400	179	2 486	73	2 468	1	389	2 457
Hydrocephalus	63	1 112	61	0 847	26	0 879	—	150	0 948
Others	6	0 106	11	0 153	8	0 270	—	25	0 158
All malformations	326	5 753	421	5 847	182	6 152	1	930	5 875
Calculated rate obtained by applying rates for whole city by parity to estimated parity constitution of each ward group	—	5 756	—	5 833	—	6 156	—	—	—

* Group I Wards with the poorest houses.
Group II Wards with houses intermediate in standard between I and III
Group III Wards with the best houses.

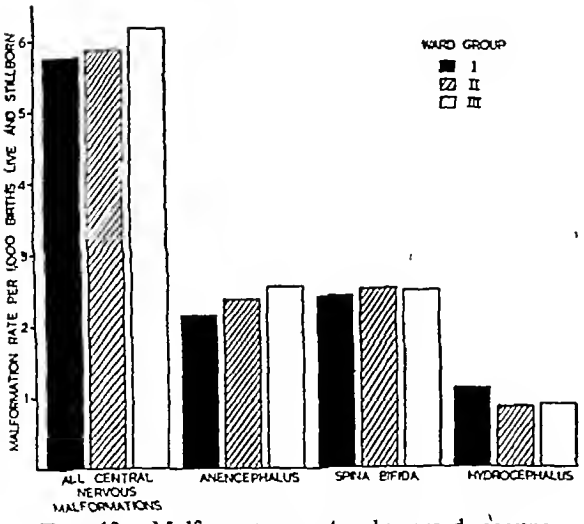

FIG 13.—Malformation rates by ward groups (Birmingham, 1940-47)

groups, and the home address of the mother at the time of the birth was used to place each malformation in one of them. Table XXXIV gives for each group the number of malformations of the three main types, and rates have been calculated from the total births (live and stillborn) in each ward group of the city for the same period, births within the city to women normally domiciled outside being excluded. (See Fig 13.)

TABLE XXXV

THE PROPORTION OF STILLBORN MALFORMATIONS CLASSIFIED BY WARD GROUPS

Malformations	Ward Group			All Wards
	I	II	III	
Stillborn	204	262	117	583
Died in first year	122	159	65	346
Total	326	421	182	929
Percentage stillborn	62 6	62 2	64 3	62 8

TABLE XXXVI

THE PROPORTION OF STILLBORN MALFORMATIONS CLASSIFIED BY WARD GROUPS (ANENCEPHALUS EXCLUDED)

Malformations	Ward Group			All Wards
	I	II	III	
Stillborn	90	101	45	236
Died in first year	115	150	62	327
Total	205	251	107	563
Percentage stillborn	43 9	40 2	42 1	41 9

TABLE XXXVII

MALFORMATION AND CONTROL GROUPS COMPARED IN RELATION TO RENT OF HOUSE

Rent of House	Malformation Group			Control Group		
	Number	Percentage		Number	Percentage	
Weekly Rent						
Less than 7*s* 6*d*	25	3 31		18	2 43	
7*s* 6*d*–9*s* 11*d*	94	12 45	45 83	106	14 29	52 43
10*s*–14*s* 11*d*	227	30 07		265	35 71	
15*s*–19*s* 11*d*	97	12 85		84	11 32	
20*s*–24*s* 11*d*	49	6 49	23 44	49	6 60	22 50
25*s*–34*s* 11*d*	26	3 44		28	3 77	
35*s* and over	5	0 66		6	0 81	
Not known	11	1 46	1 46	12	1 62	1 62
Total	534	70 73		568	76 55	
No Rent Paid						
Own house or buying it	123	16 29		103	13 88	
Living with relatives	65	8 61		50	6 74	
Other reasons	33	4 37		21	2 83	
Total	221	29 27		174	23 45	
Total	755	100 00		742	100 00	

The rate for anencephalus is slightly higher in the better ward groups, but the numbers are not large enough to be more than suggestive The proportions of malformations which were stillborn are given in Table XXXV for the three ward groups, the figure is slightly higher in the third This group, however, contains a higher proportion of anencephalus, and when this type is excluded (Table XXXVI) there is little difference between the three groups

Since the risk of malformation is related to birth rank, comparison between ward groups is not satisfactory unless the rates are standardized for parity Applying the city malformation rates for each birth rank to the population of each ward group estimated from the control series, we obtained a malformation rate per ward group almost identical with the observed rate which suggests that the increased rate in the better wards is due to the increased proportion of primiparae in these wards This result, however, must be accepted with reserve because of the rather high proportion of cases of unknown birth rank (ward group I, 16 per cent , ward group II, 12 per cent , ward group III, 19 per cent)

RENT OF HOUSE —The rent of the house was obtained in the field enquiry, and is used in Table XXXVII as the basis of a comparison between the malformation and control groups In the malformation group the percentage in houses rented at less than 15*s* per week is 6 60 (±2 58) lower than the percentage in the control series

LEGITIMACY —The civil status of the malformations was obtained from Maternity and Child Welfare Department records, and Table XXXVIII compares the proportion illegitimate with the corresponding figure for all births in Birmingham of the same period The proportion of malformations which were illegitimate is low in consequence mainly of the contribution of anencephalus The high proportion of stillbirths characteristic of this type of malformation could account for the difference, if there were evidence of less accurate reporting of civil status for stillbirths This possibility is examined in Table XXXIX, which gives the proportion of illegitimate births for stillborn and live born malformations of the nervous system, with anencephalus excluded The figures do not suggest that stillbirths are less accurately reported, and the low

TABLE XXXVIII

CIVIL STATUS OF MALFORMATIONS

Type of Malformation	All Infants	Illegitimate Infants†		Difference from percentage illegitimate in all Birmingham Births (1940–47)
	Number	Number	Percentage	
Anencephalus	366	8	2 186 (±0 764)	3 91*
Spina bifida	389	23	5 913 (±1 196)	0 18
Hydrocephalus	150	8	5 333 (±1 835)	0 76
Others	25	—	—	—
Total	930	39	4 194 (±0 657)	1 90*

* Difference exceeds twice its standard error
† Illegitimacy rate for live and still births for Birmingham (1940-1947) 6 096 per 100 (Registrar-General)

TABLE XXXIX

THE PROPORTION OF ILLEGITIMATE BIRTHS FOR STILLBORN AND LIVE-BORN MALFORMATIONS (ANENCEPHALUS EXCLUDED)

Type of Malformation	Stillborn		Infant Deaths	
	Illegitimate	Legitimate and Illegitimate	Illegitimate	Legitimate and Illegitimate
Spina bifida	9	120	14	269
Hydrocephalus	6	112	2	38
Others	—	5	—	20
Total	15	237	16	327
Illegitimate as Percentage of Total	6 329		4 893	

TABLE XL

LEGITIMACY OF STILLBIRTHS DUE TO MALFORMATIONS OF THE NERVOUS SYSTEM AND OF INFANT DEATHS DUE TO ALL CONGENITAL MALFORMATIONS IN SCOTLAND (1939–1945)

	Legitimate and Illegitimate	Illegitimate	Percentage Illegitimate
All Live Births	631,297	44,816	7 099
All Stillbirths	24,595	2,089	8 494
Total Births	655,892	46,905	7 151
Stillbirths due to			
Anencephalus	1,672	100	5 981±0 580
Spina bifida	302	19	6 291±1 397
Hydrocephalus	887	60	6 764±0 843
Total	2,861	179	6 257±0 453
Infant Deaths due to all Congenital Malformations	3,975	320	8 050±0 431

illegitimate rate for anencephalus appears to be independent of this factor

The annual reports of the Registrar-General for Scotland for the years 1939-1945 record the civil status of stillbirths for anencephalus, spina bifida and hydrocephalus, and the civil status of infant deaths for all congenital malformations grouped together (Table XL) Only anencephalus can be compared with our tables, which combine stillbirths and infant deaths Although the proportion of illegitimate births among the anencephalics in the Scottish data is considerably higher than in the Birmingham series, it is nevertheless below the proportion for all Scottish births

DISCUSSION —The Registrar-General (Decennial Supplement, 1921) suggested that social class had little effect on infant mortality from congenital malformations, a conclusion supported by Woolf (1946) from statistics for England and Wales (Table XLI) Murphy (1940) found a low proportion of well-to-do families among those from which 571 malformations were drawn, and noted that in a hospital for poor patients the incidence of malformations was twice as great as the rate for the whole city (Philadelphia) On this not very satisfactory evidence he concluded that mothers in poor social circumstances were exposed to an increased risk of the birth of a malformation, evidence in support of this view was provided by Baird (1947) who compared the numbers of malformations in two small series of births selected from private and hospital practice These reports examine the relation of social class to the incidence of all malformations, the literature contains no information on its relation to the incidence of different types of malformation

TABLE XLI

INFANT MORTALITY RATE ATTRIBUTABLE TO CONGENITAL MALFORMATIONS BY SOCIAL CLASS OF FATHER—ENGLAND AND WALES, 1930–1932. (QUOTED BY WOOLF, 1946)

Social Class	I	II	III	IV	V	All
Infant mortality rate per 1,000	5 0	5 4	5 6	5 7	5 4	5 5

The influence of the nutritional state of the mother on the risk of malformations has been considered in animals (Hale, 1933, Warkany, 1945, etc) Certainly severe vitamin deficiencies do result in the occurrence of congenital malformations of a special type in a proportion of the young of selected experimental animals, though the relation of this fact to the human problem is uncertain There is no laboratory evidence that central nervous malformations, numerically the largest group in human beings, are produced in this way Murphy (1940) and Burke and others (1933) inspected the dietary habits of pregnant women, and concluded that poor diets were common among mothers who delivered malformed births The conclusions in both cases are based on small numbers of observations and are influenced by the difficulties familiar to investigators of human dietary habits Diet is, of course, only one of the variables related to social status

MATERNAL HEALTH DURING PREGNANCY

Information about maternal health during pregnancy was obtained for the malformation and control series, by direct interrogation of the mothers Its reliability is difficult to assess not only because any patient's memory of her own illness is subject

TABLE XLII
DISABILITY DURING PREGNANCY

Disability	Type of Malformation										Controls (742)*	
	Anencephalus (305)*		Spina bifida (309)*		Hydrocephalus (118)*		Others (23)*		Total (755)*			
	No	%	No	%	No	%	No	%	No	%	No	%
First half of Pregnancy												
Vomiting of pregnancy	28	9 2	20	6 5	3	2 5	1	4 3	52	6 9	37	5 0
Threatened abortion	11	3 6	6	1 9	1	0 8	1	4 3	19	2 5	8	1 1
Severe mental shock	3	1 0	4	1 3	—	—	—	—	7	0 9	2	0 3
Falls and minor accidents	4	1 3	4	1 3	1	0 8	—	—	9	1 2	—	—
Surgical operations	1*a*	0 3	1*b*	0 3	1*c*	0 8	—	—	3	0 4	1*d*	0 1
Other major conditions	1*e*	0 3	—	—	3*f*	2 5	—	—	4	0 5	1*g*	0 1
Second half of Pregnancy												
Ante-partum haemorrhage												
Placenta praevia	3	1 0	—	—	—	—	—	—	3	0 4	—	—
Accidental	2	0 7	1	0 3	—	—	—	—	3	0 4	—	—
Unspecified	2	0 7	—	—	—	—	—	—	2	0 3	—	—
Toxaemia	15	4 9	12	3 9	10	8 5	1	4 3	38	5 0	38	5 1
Premature labour (i e at or before 36 weeks)	196	64 3	50	16 2	25	21 2	3	13 0	274	36 3	60	8 1

a Excision of skin tumour
b Operation on toe.
c Appendicectomy
d Uterine myomectomy
e Pleurisy
f Jaundice diabetes uterine fibroid
g Uterine fibroid.
* No of propositi on which percentages are based

to error, but also because it is not unlikely that mothers readily recall details of a pregnancy which resulted in an abnormal birth, whereas details after normal deliveries are quickly forgotten For example, falls and minor accidents were recorded nine times in association with the malformations, and not at all in the control series With these difficulties in mind we may consider the data for both groups in Table XLII

THREATENED ABORTION —Threatened abortion was slightly more common in pregnancies which resulted in anencephalics than in those associated with other central nervous malformations or with normal births With the exception of one case in which the mother admitted that she attempted to induce an abortion, we have no information about the cause, the facts being equally consistent with the threatened abortion of an abnormal embryo, or with defective implantation resulting in embryonic defect In either case, the figures do not recommend this as a common contribution to the aetiology of central nervous malformation The literature offers few results for comparison, but the report by Shute (1939) of 2 per cent. of deformed foetuses in 443 cases of threatened abortion treated with vitamin E or progesterone,* is consistent with this view Kotz Parker, and Kaufman (1941) published details of 184 cases of threatened abortion, associated with the birth of 102 viable infants, abnormalities were recorded in five cases (4 9 per cent), and of these only two (anencephalus and mongolism) were of a major type In further support of this view may be cited the fact (detailed in the previous section) that illegitimate pregnancies, which almost certainly experience attempts at interference more frequently than legitimate pregnancies, do not show a greater incidence of malformations

PLACENTA PRAEVIA —Placenta praevia existed in three out of 305 cases of anencephalus, and in none of the other malformations or normal births This proportion (1 per cent) is about ten times greater than that usually given for all births (0 1 per cent) and is unlikely to be due to chance Even so, the majority of anencephalics have a placenta which is normally situated, and the majority of placentae praeviae are associated with normal foetuses The association of placenta praevia with foetal deformity was first noted by Greenhill (1923), who later (1939) collected from clinic records and from the literature details of 4,446 cases of placenta praevia of which 111 were associated with deformed foetuses (2 5 per cent, as compared with 0 94 per cent in a large series of normal deliveries) Data which confirm this association were recorded by Siegal (1934), Murphy (1940), and Potter and Adair (1943)

* A series collected from the literature.

The high incidence of foetal deformities among extra-uterine embryos is well known (Mall, 1917, Hellman and Simon, 1935, Suter and Wichser, 1948), but the relevance of this observation to the malformed foetus which develops within the uterus is in doubt. Furthermore, many of these deformities are of a minor character for which a mechanical explanation may be advanced On present evidence it is not possible to say whether defective implantation of the ovum *per se* is or is not a factor of much importance in the aetiology of malformations of the nervous system

DIABETES MELLITUS —Diabetes occurred only once in the series, and was associated with the birth of a hydrocephalic infant Skipper (1933) and White (1935) reported 3 0 per cent and 4 2 per cent respectively for the incidence of malformations in 169 and 166 pregnancies in diabetic women Once again the association is noteworthy, but can scarcely be a frequent factor in the causation of malformations It is probable that the increased incidence can be, to some extent, accounted for by the fact that diabetes is usually associated with a high stillbirth rate, thus rendering available for autopsy an unusually high proportion of foetuses In this way minor internal malformations which may for a time be undetected in the live born are brought to notice

TOXAEMIA —The incidence of toxaemia is about equal in the control and malformation groups Drillien (1947) reported a lower incidence of toxaemia in pregnancies which resulted in malformations, and certainly this condition, uncommon before the sixth month, would not be expected to influence malformations which are laid down early in pregnancy

VIRUS INFECTIONS —There was no history of rubella or of any other virus infection during the pregnancies resulting in 755 malformations of the nervous system, there was also no history of virus infection in the pregnancies of the controls On this evidence we can neither confirm nor refute the suggested role of these infections in other types of malformations (which mainly exclude those of the central nervous system) but are entitled to conclude that they are not commonly associated with the malformations here investigated The earlier observations on the association of rubella with congenital defects have been reviewed by Parsons (1946) Murphy (1947), Warkany and others (1948) Others have attempted to meet the inevitable criticism of retrospective observations on malformed foetuses by noting the incidence of malformations among the births when rubella was recorded during pregnancy (Fox and Bortin, 1946, Ober and others, 1947, and Bradford Hill and Galloway, 1949) The numbers so far obtained in this way are small, but suggest an incidence considerably in excess of experience with normal pregnancies

Observations on other virus infections in pregnancy have been recorded by Dogramaci and Green (1947), Fox and others (1948), and Gerard-Lefebvre and Merlen (1948), and with one exception (Gérard-Lefebvre and Merlen) gave negative results Evans and Smith (1946) interrogated mothers who gave birth to 25 lethal malformations, and did not elicit a history of virus disease during pregnancy Influenza has also been suggested as a causal agent, but our examination of the Registrar-General s returns since 1916 indicates that the malformation rate is not correlated with the annual death rate from influenza of the same or of the previous year

THERAPEUTIC IRRADIATION OF THE FOETUS WITH RADIUM OR *X* RAYS —Evidence assembled by Murphy (1947) strongly suggested that malformations, particularly of the nervous system, can result from irradiation of the foetus *in utero* No history of irradiation was obtained in the pregnancies which produced the malformed births of our series

SEVERE MENTAL SHOCK —Popularly considered a potent factor in producing malformations, severe mental shock was recorded for seven of the malformations, and for two of the controls, for the reason stated at the beginning of this section, little attention can be paid to this slight difference in incidence It is also worth noting that the incidence of malformations was not higher in the city during the years when air raids were most frequent

PREMATURE LABOUR —Premature labour is mentioned in this context, not because it has any bearing on the aetiology of malformations but because its common occurrence when the foetus is malformed especially in cases of anencephalus, is of interest (see Table XLII) As an index of early labour the usual definition of prematurity based on the weight of the foetus would be particularly misleading in a discussion on central nervous malformations since the abnormal size of the head in many cases has an obvious relation to the infant s weight Accordingly we have based our statistics on the duration of gestation estimated from the date of the last menstrual period

Stillborn foetuses with central nervous malformations are frequently macerated indicating that death has taken place some time prior to labour presumably as a result of the malformation This accounts for a number of the cases of premature

TABLE XLIII

EMPLOYMENT OF MOTHERS OF THE CONTROL GROUP AT THE ONSET OF PREGNANCY (1940–47)*

	Year of Birth of Propositus								Total
	1940	1941	1942	1943	1944	1945	1946	1947	
Primigravidae	28 (25 0)	29 (51 7)	38 (52 6)	36 (61 1)	29 (65 5)	23 (69 6)	29 (48 3)	40 (42 5)	252 (51 6)
Multigravidae	45 (11 1)	43 (20 9)	49 (10 2)	56 (23 2)	77 (18 2)	64 (15 6)	71 (15 5)	85 (14 1)	490 (16 1)
Total	73 (16 4)	72 (33 3)	87 (28 7)	92 (38 0)	106 (31 1)	87 (29 9)	100 (25 0)	125 (23 2)	742 (28 2)
Nervous Malformation rate per 1,000 (all city births)	7 43	6 55	6 98	6 48	5 52	5 03	5 46	4 52	5 87

* The table gives the total number of women in each group and in brackets the percentage of these employed in a remunerated occupation at the onset of pregnancy

TABLE XLIV

COMPARISON BETWEEN MALFORMATION AND CONTROL GROUPS IN RESPECT OF WORK OF MOTHERS IN EARLY PREGNANCY

Work of Mother	Primigravidae				Multigravidae			
	Malformations		Controls		Malformations		Controls	
	No	Percentage	No	Percentage	No	Percentage	No	Percentage
No work	8	2 40	4	1 59	9	2 15	19	3 88
Own housework with help	27	8 08	15	5 95	52	12 41	27	5 51
Own housework without help	95	28 44	104	41 27	266	63 48	365	74 49
Remunerated employment only	59	17 66	17	6 75	14	3 34	6	1 22
Remunerated employment and own housework with help	37	11 08	27	10 71	9	2 15	7	1 43
Remunerated employment and own housework without help	108	32 34	85	33 73	69	16 47	65	13 47
Total	334	100 00	252	100 00	419	100 00	490	100 00
Total engaged remuneratively	204	61 08±2 67	129	51 19±3 15	92	21 96±2 02	79	16 12±1 66
Differences between percentages (Malformations—Controls)	9 89%±4 13				5 84%±2 61			

labour Hydramnios is a not uncommon complication of pregnancies which result in a congenital malformation, being particularly frequent in cases of anencephalus (Drillien, 1947), and no doubt many of the cases of premature labour in our series were due to the mechanical distension of the uterus from this cause

MATERNAL OCCUPATION DURING PREGNANCY

Information was obtained in the field enquiry about the work done during pregnancy by mothers in the malformation and control groups, and the increased proportion of mothers in remunerated employment during the war years is demonstrated separately for primigravidae and multigravidae in Table XLIII In 1943, 38 per cent of mothers were remuneratively employed at the onset of pregnancy, the figures being 61 per cent and 23 per cent for primigravidae and multigravidae respectively The reduction in the malformation rates over these years has already been discussed, and no conspicuous association with the incidence of maternal employment is evident This problem is further investigated in Table XLIV which shows

TABLE XLV

OCCUPATION OF MOTHERS AT THE ONSET OF PREGNANCY

Type of Occupation	Malformation Group			Control Group		
	No	Percentage		No	Percentage	
Professional and executive	11	3 7	34 4	8	3 8	26 0
Clerical	56	18 9		28	13 5	
Shop assistants and occupations of similar status	35	11 8		18	8 7	
Factory work						
Supervision	1	0 3	50 6	2	1 0	57 2
Viewing and assembling	53	17 9		27	13 0	
Filing, painting, and machine work	63	21 3		51	24 5	
Store-keeping and packing	6	2 0		7	3 4	
Other manual work	27	9 1		32	15 4	
Public house, canteen and restaurant work	13	4 4	12 2	11	5 3	13 9
Laundry and domestic work, office cleaning	16	5 4		15	7 2	
Public transport—conductresses, porters	7	2 4		3	1 4	
Armed Forces	4	1 4		1	0 5	
Unspecified	4	1 4		5	2 4	
Total	296	100 0		208	100 0	

TABLE XLVI

STAGE OF PREGNANCY WHEN MOTHERS CEASED EMPLOYMENT

Duration of Gestation (weeks)	Primigravidae				Multigravidae			
	Malformations		Controls		Malformations		Controls	
	No	Percentage	No	Percentage	No	Percentage	No	Percentage
Less than 12	32	15 7	14	10 8	16	17 4	9	11 4
12–15	31	15 2	33	25 6	19	20 7	8	10 1
16–19	31	15 2	14	10 8	8	8 7	5	6 3
20–23	35	17 2	21	16 3	14	15 2	16	20 3
24–27	41	20 1	20	15 5	14	15 2	13	16 5
28–31	25	12 2	13	10 1	9	9 8	10	12 7
32–35	5	2 4	9	7 0	5	5 4	5	6 3
36–39	3	1 5	4	3 1	4	4 3	10	12 7
40+	—	—	1	0 8	3	3 3	2	2 5
Unspecified	1	0 5	—	—	—	—	1	1 3
Total	204	100 0	129	100 0	92	100 0	79	100 0
Mean (weeks)	20 6		21 1		21 2		24 5	

for primigravidae and multigravidae of the malformation and control series the circumstances in respect of work in early pregnancy, the proportion of mothers remuneratively employed is higher for the malformations Table XLV records the type of work done, and shows a slightly higher percentage of manual workers in the employed of the control group Information obtained about the stage in pregnancy in which mothers left regular employment (Table XLVI) shows slight differences between the two groups which could be explained by the more frequent premature onset of labour in the malformations

The data here recorded about employment of women in pregnancy during and since the war have some intrinsic interest It is however necessary to be cautious about drawing any conclusion from differences between control and malformation groups of the dimensions shown in the accompanying tables, and we limit our conclusion to the statement that there is at least no noteworthy association between the proportion of mothers remuneratively employed and the incidence of congenital malformations of the nervous system

SUMMARY

1 In the years 1939 to 1945, congenital malformations in Scotland were responsible for 11 7 per cent of the certified deaths of infants, stillborn or dead within the first year of life National statistics for England and Wales do not give the causes of stillbirths but, in the years 1941 to 1945, attribute to the same causes about 10 per cent of first year deaths

2 Scottish data (1941-45) show that malformations of the central nervous system accounted for at least 72 per cent of stillborn and 39 per cent of live born malformations which died in the first year of life, or for 55 per cent of the combined total

3 Data from Birmingham Maternity and Child Welfare Department records are examined in respect of 930 consecutive malformations of the central nervous system certified as the cause of stillbirths or of first year deaths in the city in the years 1940 to 1947 They were classified as follows anencephalus (366), spina bifida (389), hydrocephalus (150), others (25) From this material evidence is provided of

(a) The frequency with which different types of malformation are associated in one individual
(b) The sex-ratio of the central nervous malformations
(c) Secular trends The rate for hydrocephalus remained fairly constant in the 8-year period The rates for anencephalus and spina bifida declined, and it is suggested that the observed reduction may be accounted for by the change in parity of the mothers

4 By home visits additional information was obtained from mothers of 755 of the 930 malformations, and from mothers of 742 of 876 births not resulting in malformations, selected by taking every 200th name from the registers of live and stillbirths for the same years

5 The association of the age and parity of the mother with the risk of birth of a central nervous malformation was examined in a comparison of the malformation and control groups, with the following results

(a) Considering all the central nervous malformations together, risks of the birth of a malformation are considerably increased at the first parity and above the sixth, and are correspondingly reduced between these extremes Variations in association with maternal age are also present but are less marked
(b) Considering the main groups separately, results for anencephalus and spina bifida are similar to those for the whole series In the case of hydrocephalus, the effect of birth rank is slight when compared with the marked effect of high maternal age

6 Locality of domicile, rent of house, and legitimacy of the birth were used as indices of social status, they do not reveal any notable differences in the incidence of central nervous malformations

7 The incidence of maternal illness or of other maternal disability during pregnancy is recorded There was no history of rubella or of other virus infection during the pregnancies resulting in the 755 malformations of the central nervous system

8 Information is also recorded about maternal employment during pregnancy There was no noteworthy association between the proportion of mothers remuneratively employed and the incidence of congenital malformations of the nervous system

Many people assisted the work of this enquiry, and we acknowledge our indebtedness to the following Dr Jean Mackintosh and members of the Birmingham Maternity and Child Welfare Department who co-operated fully in making available to us the records of the department, Dr Dorothy Tidmas, who completed a preliminary survey of the malformations of one year, Mrs Kathleen Gibson, Miss Mary Edge, Mrs Burgess Smith, Mrs Leaver, Miss Day, Miss Bayes, and members of the Almoners' Department of the United Birmingham Hospitals, all of whom took part in the field work, and Miss Catherine Wall, who prepared the figures used in the text Dr Enid Charles and Sir Leonard Parsons read the typescript and offered useful suggestions Finally, and in particular, we record our gratitude to Prof Lancelot Hogben, F R S, who has contributed most generously to this enquiry

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APPENDIX A

Classification of Birmingham City Wards into Three Social Groups

In Birmingham certain statistics can be prepared separately for each city ward, and since alternative indices of social status are often not available, a classification of wards into social groups is of value For many years the annual reports of the Medical Officer of Health have given statistics for central, inner and outer rings, a classification based on the wards and related broadly to social differences This classification introduces certain anomalies Edgbaston, for example, is in the inner ring, but having been reserved as a high-class residential area, contains few working-class dwellings, in the outer ring some wards have a high proportion of municipally-owned houses occupied by residents of the artisan class, while others have mainly privately-owned houses, many occupied by professional and business men We have therefore re-classified the wards, using data from three sources

(1) The Housing Survey Report, 1946, gives for each ward the number of houses (*a*) back-to-back, (*b*) with a bathroom (*c*) with a bath (*d*) municipally-owned
(2) The Birmingham City Statistical Office* has supplied the average rateable values for each ward
(3) The Town Planning Department gave the surface area of each ward, from which were calculated by wards (*a*) housing densities, (*b*) population densities, using the ward population given in the Report of the Medical Officer of Health 1947

Table A and Fig A (overleaf) give the data on which the 34 city wards were divided into three groups

Group I Fifteen wards with a high proportion of substandard houses These include all the central wards and the more highly industrialized wards of the inner ring, it accommodates mainly the families of workers with low incomes
Group II Twelve wards with houses of a higher standard than Group I The most significant feature is the high proportion of municipally-owned houses in eight wards These houses are also occupied mainly by working-class families
Group III Seven wards with a high general level of housing All except Edgbaston are in the outer ring and well removed from the industrial areas

Infant mortality and live birth rates for the years 1946 and 1947 show considerable differences between the three ward groups (Table B, overleaf, and Fig B, below)

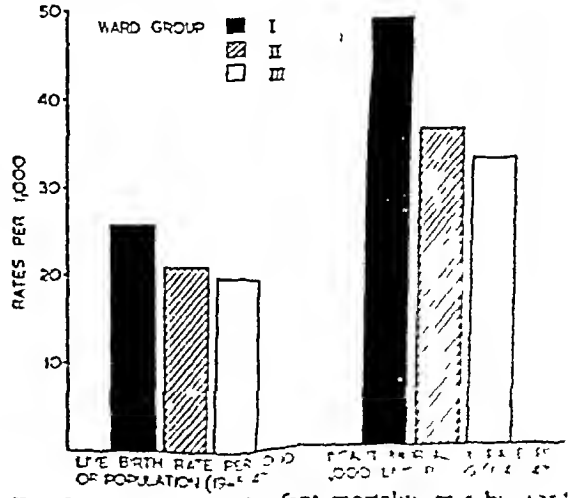

FIG B—Birth rate and infant mortality rate by ward groups (Birmingham 1946–7)

* We are indebted for this material to Dr Enid Charles

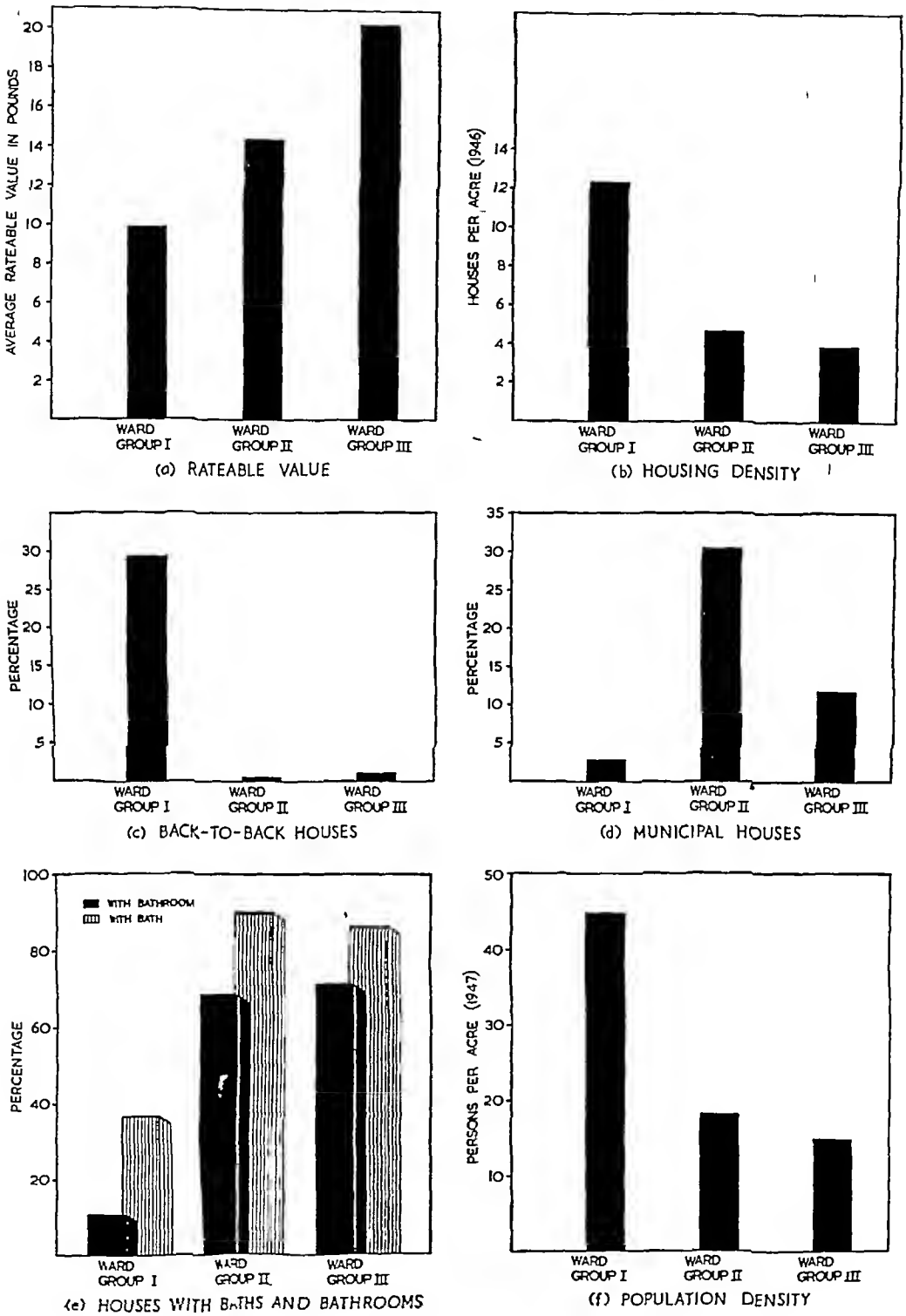

FIG A —Housing details by ward groups (Birmingham, 1946-47)

APPENDIX A, TABLE A

HOUSING STATISTICS OF WARD GROUPS IN BIRMINGHAM (1946)

Municipal Ward	Percentage of Dwelling Houses				Average Rateable Value (1947) £	Housing and Population Density	
	Back-to-back type	With bathroom	With bath	Municipally owned		Houses per Acre	Persons per Acre
I St. Mary's	47 2	3 9	27 1	0 0	7 61	10 7	41 6
Duddeston and Nechells	29 1	3 8	29 8	2 6	7 84	12 2	44 3
St Bartholomew's	26 7	6 8	22 5	6 7	7 90	9 0	32 1
St Paul's	63 8	2 0	38 3	0 0	7 93	12 8	44 0
All Saints'	29 9	2 5	45 1	0 4	8 43	15 8	52 8
Ladywood	61 0	3 2	20 9	0 6	8 45	19 0	65 0
St. Martin's	49 7	8 5	31 2	5 3	8 98	12 3	46 2
Market Hall	64 7	4 8	28 4	0 0	9 20	9 1	32 1
Aston	24 8	5 9	37 9	0 0	9 25	14 1	50 7
Saltley	1 9	29 5	49 0	13 4	11 03	6 4	24 0
Rotton Park	26 5	15 5	42 6	0 0	11 34	12 0	42 1
Lozells	21 1	5 0	31 8	0 5	11 63	19 5	70 8
Small Heath	4 4	27 9	57 6	13 7	11 70	13 3	50 4
Sparkbrook	7 5	16 7	34 4	0 0	11 75	11 4	45 2
Balsall Heath	11 0	15 9	35 4	0 0	11 95	18 1	64 2
Average for Group I	29 3	10 8	36 5	2 87	9 86	12 38	44 76
II Washwood Heath	0 8	62 7	81 8	17 4	12 94	4 9	19 1
Selly Oak	0 7	53 8	82 6	9 6	13 91	5 3	18 6
Soho	5 2	41 9	77 6	1 7	15 60	9 2	33 6
Sparkhill	0 5	52 0	67 2	2 7	16 13	7 6	27 8
Bromford	3 0	44 7	78 2	32 3	13 46	2 9	11 7
Perry Barr	0 0	86 5	99 8	35 3	13 47	6 1	25 3
Yardley	0 2	62 7	88 6	28 4	13 84	6 5	25 5
Stechford	0 0	89 7	98 7	42 4	13 89	3 1	13 1
Erdington	0 7	61 7	87 8	39 4	14 54	7 0	28 3
Acocks Green	0 1	56 1	94 0	44 8	14 58	7 4	30 0
Northfield	0 1	82 9	95 9	38 9	14 65	2 3	8 3
Hall Green	0 0	72 8	99 5	41 6	16 37	6 3	24 8
Average for Group II	0 6	68 4	90 0	30 3	14 40	4 63	18 15
III King's Norton	0 3	73 4	82 8	11 3	16 50	3 0	11 0
Gravelly Hill	0 2	75 0	86 0	21 9	16 58	4 1	17 7
Sandwell	0 4	56 3	77 6	2 5	17 77	4 1	14 2
Harborne	0 2	76 9	86 8	15 1	18 80	4 2	14 9
Handsworth	1 7	60 1	85 4	1 4	19 16	5 6	21 2
Moseley and King s Heath	0 1	74 0	91 5	21 7	20 80	4 5	17 5
Edgbaston	5 8	75 4	88 9	0 0	34 81	2 8	11 5
Average for Group III	1 1	71 1	86 1	11 8	20 27	3 87	14 77
Whole City	10 3	49 7	71 3	17 1	—	5 56	21 08

APPENDIX A, TABLE B

VITAL STATISTICS OF WARD GROUPS IN BIRMINGHAM (1946–1947)

Vital Statistics	Ward Group			All Wards
	I	II	III	
Birth rate	25 7	21 0	19 7	22 4
Infant mortality rate	49 2	36 5	33 1	40 4

Brit J soc Med (1949), 4, 220-227

MORTALITY FROM TUBERCULOSIS IN SOME COUNTRIES

BY

GUNNAR DAHLBERG

From the State Institute for Human Genetics and Race Biology, University of Uppsala

Comparison of the Tuberculosis Death-rate in Various Countries

Valid comparison between tuberculosis mortality rates of different countries has to take stock of the fact that the death-rate from tuberculosis is not the same for the two sexes and of the fact that it is not the same in different age groups It is, therefore, misleading to compare crude rates, i e the annual number of deaths per 1,000 inhabitants Obviously, a country with a high birth-rate will have a high death-rate from tuberculosis if the tuberculosis death-rate is very high among very young persons (less than 1 year old), albeit the death-rates for separate age groups might not then show any differences at all To eliminate the source of error inherent in this circumstance, one may use figures for the cumulative risk of dying from tuberculosis, by adding figures for the various age groups Figures obtained by this means are independent of the age distribution of the population We may thus follow up 1,000 persons through the course of life and calculate how many die from tuberculosis provided that they do not die for some other reason

TABLE I

Tuberculosis Death-rate in Different Age groups in England, France, and Sweden

Age (years)	England and Wales, 1936		France, 1931-35		Sweden 1931-35	
	M	F	M	F	M	F
5	0 4	0 4	0 9	0 9	0 7	0 7
10	0 5	0 5	1 3	1 3	1 1	1 2
15	0 7	1 1	2 0	2 7	1 8	2 6
20	2 5	4 4	5 6	8 5	5 9	8 6
25	6 5	9 8	13 1	17 5	13 2	17 7
30	10 8	14 1	21 8	25 9	20 2	25 9
35	14 9	17 4	32 5	32 9	26 1	32 6
40	19 6	20 3	44 2	39 0	31 4	38 0
45	24 5	22 7	55 9	44 3	36 2	42 6
50	30 5	24 8	68 0	48 8	40 8	46 5

In doing so, one neglects differences with reference to general mortality in different populations, but if it is desirable to take this into account we can express

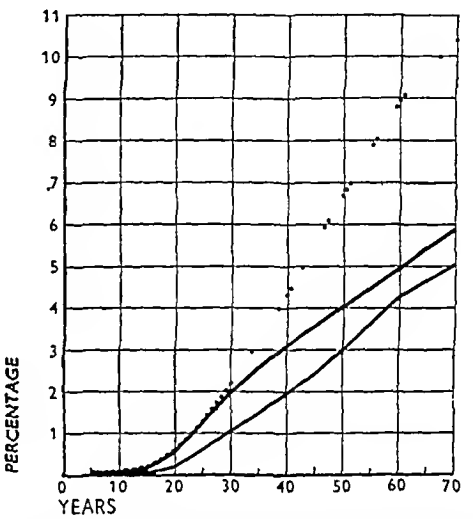

Fig 1—Diagram of the cumulative death-rate from tuberculosis up to different age-limits for men, in France (the dotted line), Sweden (the upper whole line), and England (the lower whole line)

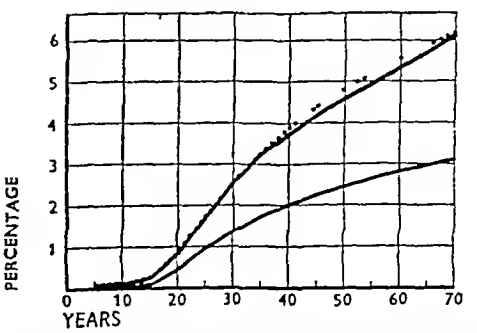

Fig 2—Diagram of the cumulative death-rate from tuberculosis up to different age-limits for women, in France (the dotted line), Sweden (the upper whole line), and England (the lower whole line)

TABLE II

COMPARISON BETWEEN THE TUBERCULOSIS DEATH-RATES IN DIFFERENT COUNTRIES

Country	Year	Tuberculosis death-rate per 10,000 inhabitants		Cumulative death risk at 50 years of age per 1,000 inhabitants		Cumulative death risk at 60 years of age per 1,000 inhabitants	
		M	F	M	F	M	F
Denmark	1931-35	4 3	5 0	20 5	24 5	26 0	29 0
U S A.	1930	6 5	5 6	30 1	27 8	40 8	33 3
Germany	1932-36	6 6	5 5	28 5	25 4	38 7	30 6
Italy	1936	6 6	6 4	35 6	35 0	45 3	40 5
England and Wales	1936	7 0	4 7	30 5	24 8	43 2	28 5
Sweden	1931-35	8 6	9 4	70 8	46 5	50 1	53 6
Norway	1931-35	10 2	10 4	52 8	53 9	62 9	56 0
France	1931-35	13 8	7 9	68 0	48 8	90 0	62 5
Finland	1931-35	17 7	17 3	81 9	89 3	107 6	102 2

the tuberculosis death-rate as a percentage of the general death-rate The percentage will, of course, be different in different age groups In comparing different populations, it may then be useful to cite the mean of percentage for all age groups

Table I and Figs 1 and 2 cite cumulative or total death risk for England and Wales (1936), France (1931-35), and Sweden (1934-36) to illustrate how to carry out the relevant computations At the age limit of 50 years we find that 4 1 out of 100 Swedish men die of pulmonary tuberculosis, and 4 6 out of 100 women Corresponding figures for England are 3 1 and 2 5 The figures for France are higher, 6 8 for men and 4 9 for women

Table II cites for different countries both the cumulative death-rate from pulmonary tuberculosis up to 50 years, and the ordinary death-rate, i e how many die per 10,000 persons It exhibits both the differences with regard to risk of death at two age levels, and also what distortion of the risk may arise from reliance on crude death-rates Table III exhibits the overall death-rate in tuberculosis expressed as a percentage of the general death-rate It also cites mean figures of the percentage of deaths from pulmonary tuberculosis out of all deaths in various age groups

Relevant comment on the contents of these tables will be found below Here it suffices to emphasize the value of figures for cumulative risk if our aim is to compare statistics of different countries

TABLE III

COMPARISON BETWEEN THE PERCENTUAL TUBERCULOSIS DEATH-RATES IN DIFFERENT COUNTRIES

Country	Tuberculosis death-rate as percentage of general death-rate		Mean of the percentual Tuberculosis death-rates in different age groups up to 60 years	
	M	F	M	F
Denmark	3 9	4 6	11 7	15 3
Italy	4 6	4 9	14 2	16 6
England and Wales	5 4	4 1	14 9	15 8
U S A	5 5	5 6	10 4	12 2
Germany	5 7	5 1	13 8	15 4
Sweden	7 5	8 0	19 7	24 6
France	7 6	5 9	19 0	18 6
Norway	9 6	10 0	21 2	26 9
Finland	13 1	14 2	23 2	31 6

THE NUMBER OF TUBERCULIN-POSITIVE PERSONS IN SWEDEN

By making tuberculin tests it may fairly certainly be ascertained whether a person has ever been infected by tuberculosis Different kinds of tuberculin tests exist, but nowadays it is generally held that the Mantoux test, involving an intracutaneous injection of 1 mg tuberculin, gives the best results In Sweden, Mantoux tuberculin tests have now been carried out on a comparatively large scale thanks to the National Anti-Tuberculosis League It has thus been possible to get some idea of the number of persons infected by tuberculosis in the Swedish population The material comprised 11,500 individuals and a statistical treatment of the data was carried out in the State Institute for Human Genetics and Race Biology Fig 3 (overleaf) shows that the incidence of tuberculin-positive reaction rapidly increases from school age onwards, and attains a maximum in the age group 40-45 by which time 98 per cent of the population is Mantoux-positive It may further be stated that the frequency of tuberculin-positive reaction seems to drop slightly in the higher age

groups, i e after 60 years of age Moreover, it is interesting to note that the curve for women seems to lie consistently at a slightly lower level than that for men The difference is not large but it is statistically significant throughout, and is greatest about the age of 25

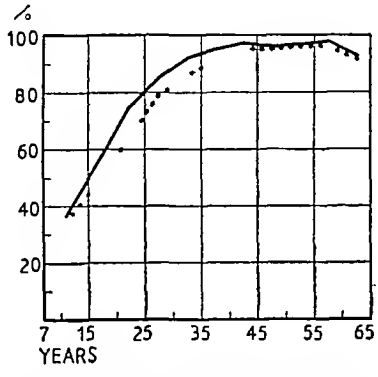

FIG 3 —Percentage of tuberculin-positive persons in different age-groups in Sweden
Dotted line=women Whole line=men

In any case, the figures obtained show that (*a*) almost every individual sooner or later becomes tuberculin-positive, (*b*) under the social conditions existent in Sweden this occurs in many instances well on in adult life Seemingly, no comparable figures are available for other countries If tuberculin surveys have been carried out elsewhere, the numerical material does not seem to have been assembled in this form, but we may assume that data from other countries, if available, would follow a similar curve

THE SPECIFIC DEATH-RATE FROM TUBERCULOSIS AT VARIOUS AGES IN DIFFERENT COUNTRIES

Fig 4 shows the age distribution of the tuberculosis death-rate in Sweden It is high during the first year of life, sinks to a minimum about the age of 5 and again increases to a maximum in the 25-year-olds It then drops anew to rise again, but not so much, about the age of 60 It is remarkable furthermore, that (*a*) the tuberculosis death-rate apparently increases, first in women and somewhat later in men, up to the age of 25, (*b*) men have a higher mortality than women about the age of 50 though the difference is not large It should be emphasized that curves referable to different decades are comparable, though the general level is higher at an earlier period

Fig 5 discloses the picture for Norway in the years 1931-35 The contour of the curves is much the

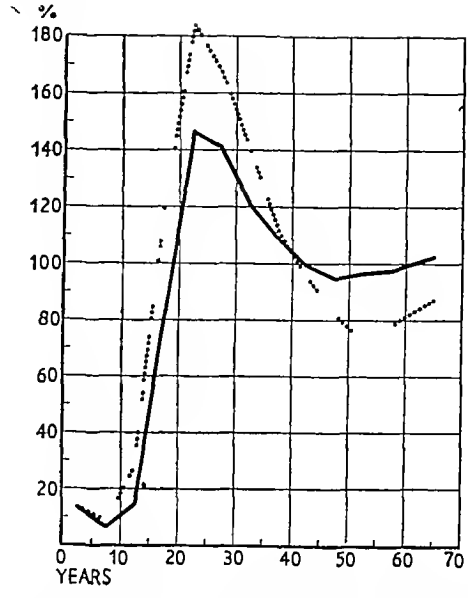

FIG 4 —Tuberculosis death-rates in Sweden, 1931-35
Dotted line=women. Whole line=men

same as in Fig 4, but the sex difference in Norway is more striking Men show a higher mortality rate, but the tuberculosis death-rate of women still rises

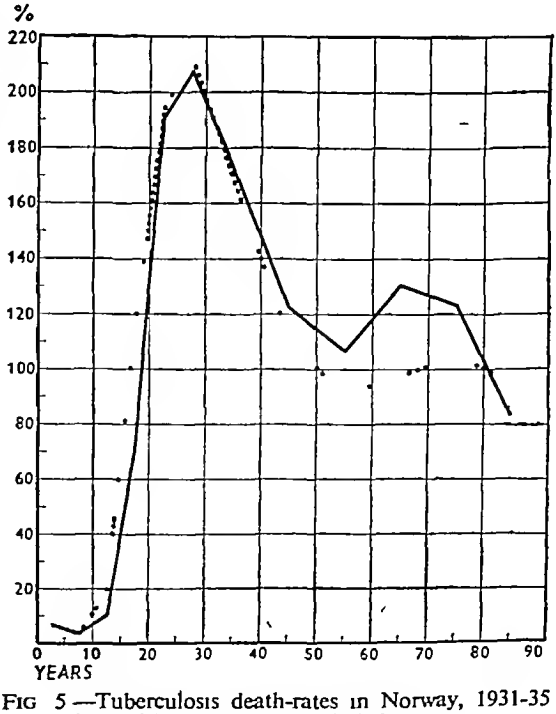

FIG 5 —Tuberculosis death-rates in Norway, 1931-35
Dotted line=women Whole line=men

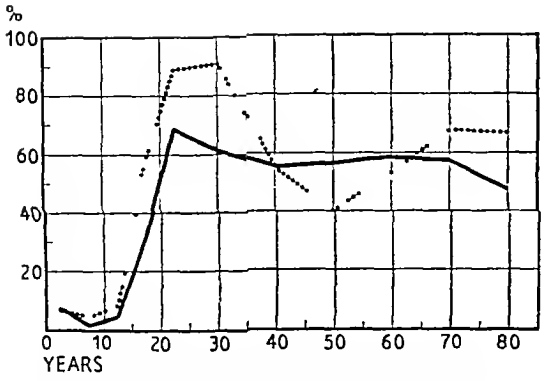

FIG 6.—Tuberculosis death-rates in Denmark, 1931-35
Dotted line=women Whole line=men

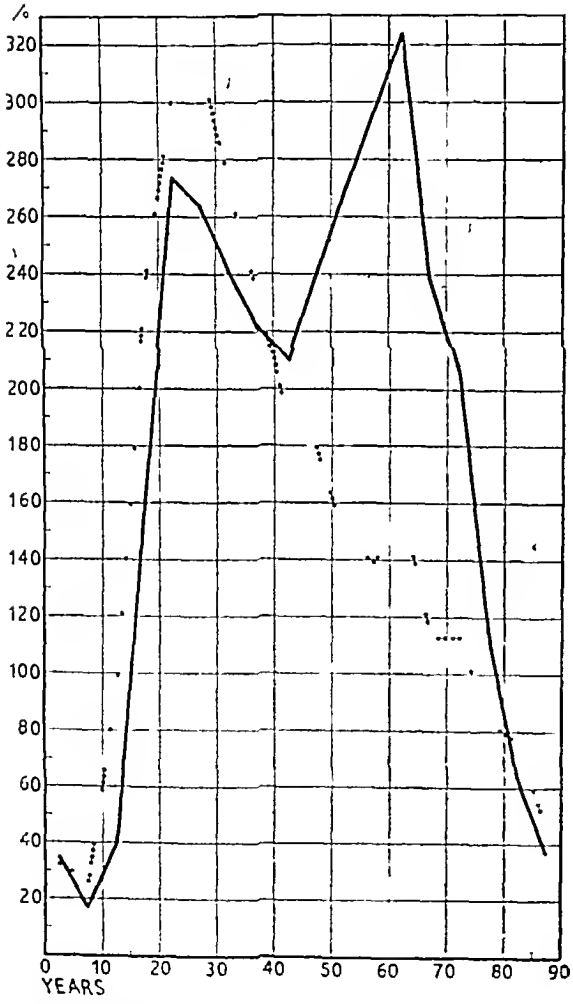

FIG 7.—Tuberculosis death rates in Finland, 1931-35
Dotted line=women Whole line=men

somewhat earlier Corresponding statistics for Denmark (Fig 6) differ as a whole more conspicuously from those of Sweden The mortality amongst women reaches its maximum about the age of 30, falling thereafter, while that amongst men continues to rise to an advanced age

Finland takes an intermediate position (Fig 7) The death-rate for women has the same hump as in the countries already discussed The men, on the other hand, reach a maximum about the age of 25, whereupon their mortality decreases, to rise again as from the age of 40 Apart from this, the tuberculosis mortality in Finland lies on a far higher level than in the other Nordic countries

It would be merely tiresome to include tuberculosis mortality data for all the countries for which statistics are available We therefore confine ourselves to those of England and Wales, Germany,

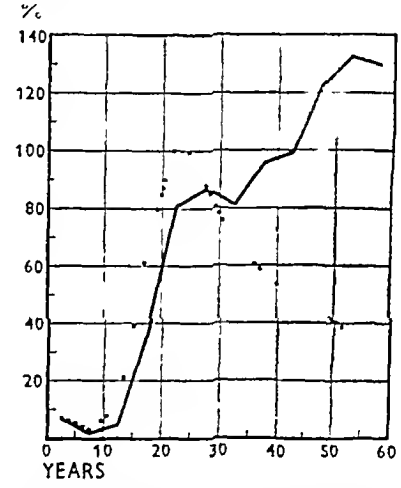

FIG 8.—Tuberculosis death-rates in England and Wales, 1936 Dotted line=women Whole line=men

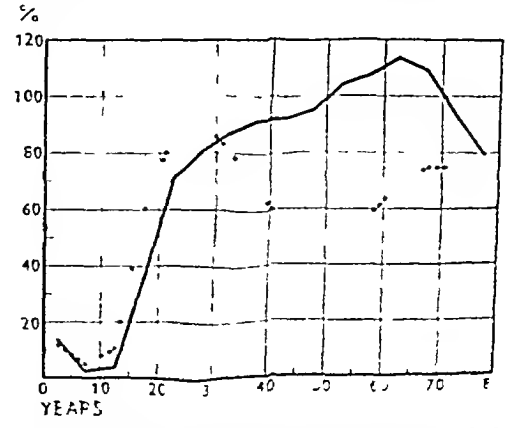

FIG 9.—Tuberculosis death rates in Germany 1932-3
Dotted line=women Whole line=men

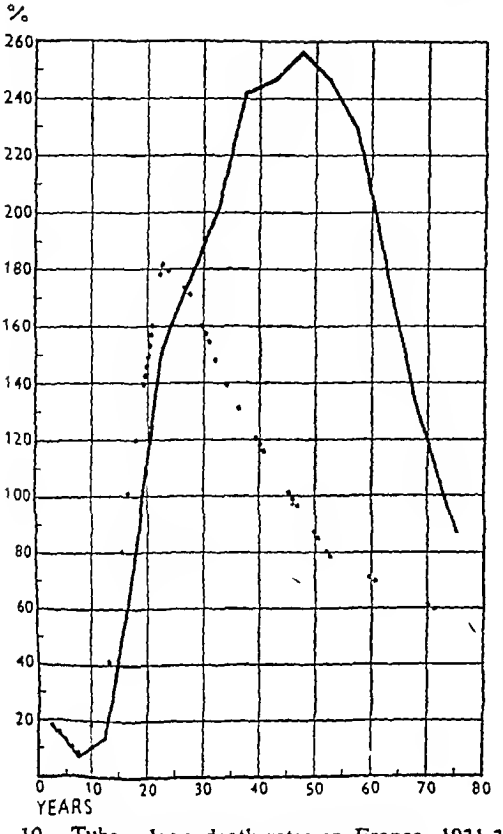

FIG 10.—Tuberculosis death-rates in France, 1931-36
Dotted line=women Whole line=men

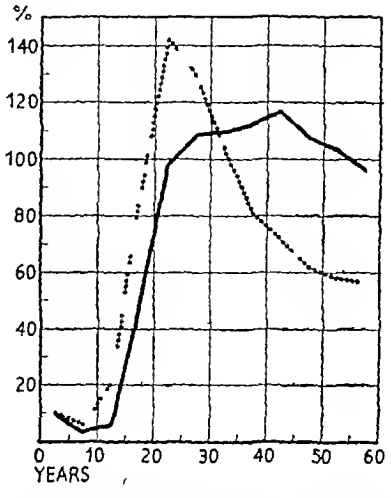

FIG 11.—Tuberculosis death-rates in Italy, 1936
Dotted line=women Whole line=men

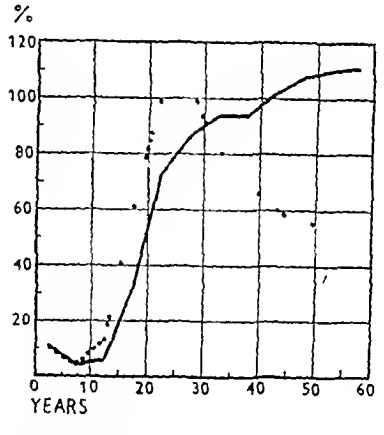

FIG 12.—Tuberculosis death-rates in the U S A, 1930
Dotted line=women Whole line=men

France, Italy, and the U S A It should be emphasized that the curves in Figs 8-12 are drawn to the same scale, and are consequently comparable They all refer to the years before the second world war It is remarkable that they lie on such different high levels Common to all is the fact that mortality of women drops after the age of 30 while in men it continues to rise In this respect, the difference between the sexes is most pronounced in France, and that country also exhibits the peculiarity that in old age male mortality has a downward trend

DISCUSSION

Common to all the data cited, as repeatedly emphasized, is the more rapid rise of the death-rate from tuberculosis before the age of 20 in women as compared with men One gains the impression that puberty plays a decisive part in this phenomenon For as a rule puberty sets in earlier in females than in males Whether or not hormonal readjustment taking place at this time makes any difference, or whether the causative factor underlying the increase is the beginning of work, it is at present impossible to decide

A second issue worthy of comment is the difference between trends for men and women after the age of 30 In two Scandinavian countries the curve drops in the same way for both men and women, though the male decrease is less pronounced In Denmark, on the other hand, the curve rises after the age of 30 fo men but not for women, and the same thing happens in the larger countries Naturally these discrepancies cannot be due to unreliable figures Differences of the magnitude we are dealing with here can hardly have such causes Nor can it be assumed that racial differences are to blame For a racial difference could scarcely affect the men only

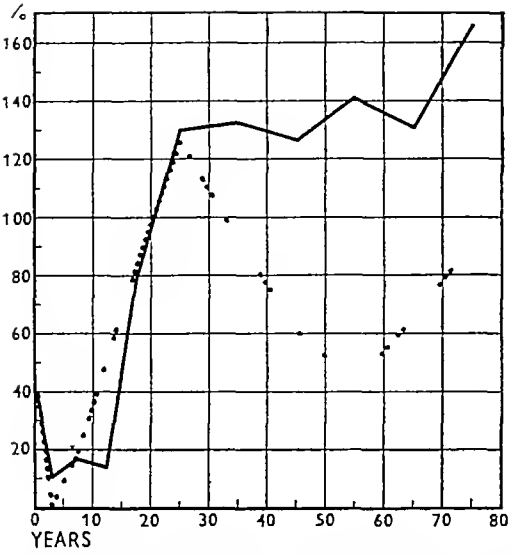

FIG 13 —Tuberculosis death-rates in Stockholm, 1934-36
Dotted line=women Whole line=men

So far as I can find, the meaning of these differences has received little attention A likely view is that they are due to a greater measure of urbanization in the larger countries This I suggested in a a lecture to the Swedish Medical Association in

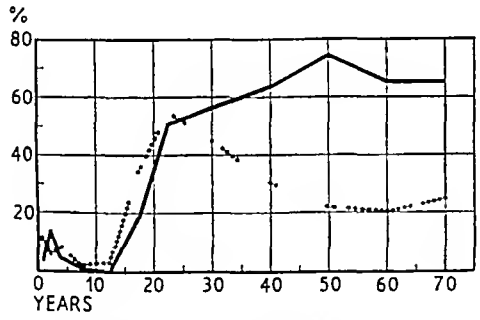

FIG 14 —Tuberculosis death-rates in Copenhagen (including Frederiksberg), 1944-46
Dotted line=women Whole line=men.

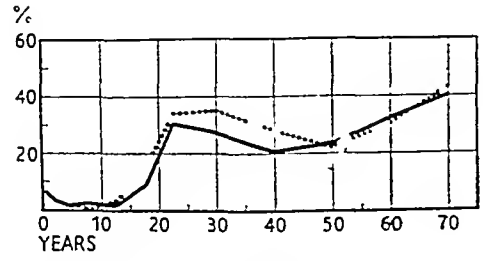

FIG 15 —Tuberculosis death-rates in rural districts of Denmark, 1944-46
Dotted line=women Whole line=men

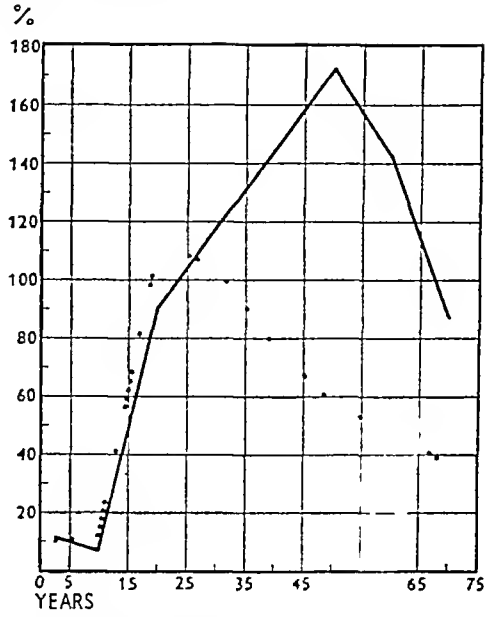

FIG 16 —Tuberculosis death rates in urban centres of England and Wales, 1931
Dotted line=women Whole line=men

1943 (published 1944) Similar views were propounded by Malthete (1946) In cities men's work brings them into contact with persons suffering from tuberculosis, so that they contract the disease and die to a far larger extent than women Advancing industrialization naturally entails growing hazards of the same kind for women too but not to the same degree as for men If this hypothesis is correct it should be possible to obtain a difference between conditions in Stockholm and those in other parts of Sweden Fig 13 shows that men in Stockholm do indeed

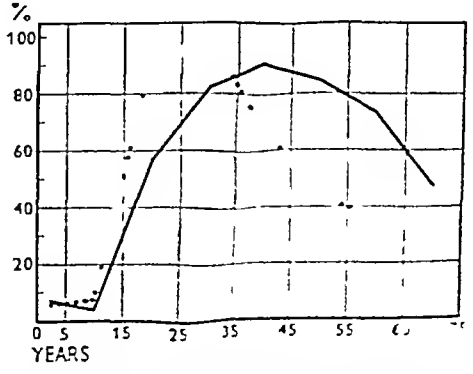

FIG 17 —Tuberculosis death rates in rural districts of England and Wales 1931
Dotted line=women Whole line=men

conform to the continental pattern, and that in middle age they run far greater risks than women For Denmark, one can sharply differentiate Copenhagen from purely rural districts, see Figs 14 and 15, which also show the metropolis to be more hazardous in middle-age for men than for women Contrariwise, the countryside conforms to the curves of the other Scandinavian countries We may therefore state that the anomalous contour of the Danish curves in Fig 6 is due to the fact that there Copenhagen, far more than Stockholm in Sweden, dominates the picture as a whole

As regards the death-rate from tuberculosis in other countries, separate figures for town and country have been obtainable only for England and Wales (Figs 16 and 17) There the sex difference is far greater in the larger cities than in more rural districts, though no figures are available for purely rural districts

All our assembled data consequently support the hypothesis that infection at the place of work in adult life is of decisive importance for the death-rate among men of middle-age

In this connexion, it is tempting to take a further step by asking whether such infections are to be considered as first or subsequent infections The graph of Fig 3 has some relevance to this issue In present-day Sweden almost everybody will be infected sooner or later In a metropolitan population one may surmise that the tuberculin-positive reaction curve will rise more rapidly than in Sweden If so, reinfections should play a not unimportant part, and the majority of those who die after adolescence should have been infected already at an earlier age The importance of reinfections has now been the object of discussion for many decades without agreement or decisive proof, and at different times diverse opinions have been more or less fashionable Though the data under discussion may not be wholly conclusive, it is suggested that reinfections in adult life are of greater importance than has hitherto been thought likely in many quarters

Different levels of the tuberculosis death-rate in different countries prompt us to examine the following conceivable possibilities

1 The character of the pathogenic organism may be different in different countries However, there are no data indicating that the virulence is not the same Accordingly it is not profitable to discuss this possibility, albeit we cannot with certainty exclude it

2 The chance of being infected is more or less likely in various countries That differences may exist in this respect is shown, for instance, by this investigation Improved communications, increased industrialization, etc , are naturally accompanied by more numerous human contacts Cleanliness and hygiene may lie on different levels It would seem to be doubtful, however, if differences of this kind can provide the whole explanation

3 The vital resistance of different peoples may be unequal This resistance is to some extent dependent on nutritional status As nutrition goes down susceptibility goes up This is shown, for example, by higher mortality from tuberculosis at the end of the first world war in Germany and France It is difficult, however, to trace any parallelism between the figures given here and the standard of nutrition in various countries To be sure, the vital resistance of a population may also be genetically determined, but we do not know why the genetical composition should in this respect be different in different countries

It is a fact that the death-rate from tuberculosis has of late decreased In Sweden, for example, in the towns it was 2 8 per thousand in 1890, and in the whole country it was 1 6 per thousand in 1910, 1 03 per thousand in 1930, and 0 49 per thousand in 1945 The decrease seems to have been almost linear, and it is noteworthy that the death-rate started to decrease before the new treatments and sanatoria could possibly have had any effect Even if these subsequently contributed to the decrease, it is difficult to estimate their role, the physician is perhaps inclined to overestimate their importance and, besides these, two other factors remain to be discussed

One is the effect of selection, individuals who contract tuberculosis in a more severe form and should therefore as a rule be particularly susceptible to tuberculosis often fall ill and die comparatively early, being thereby prevented from procreation This implies that, in so far as tuberculosis is dependent on genetical factors, the latter are subject to selection Such a mechanism undoubtedly exists, but the recognition of its existence leaves unanswered the question how great is its effect ? In principle, it is safe to say that had the disease been relatively common for several centuries, selection would have had time to exert its main influence long ago For selection, of course, is most effective in the beginning When, as a result of it, the frequency of the relevant genes decreases, its effect becomes progressively smaller and eventually insignificant In this respect, it is difficult to say anything definite about tuberculosis We know that the disease has existed for a very long time, but we know nothing of its prevalence in bygone days when it could not even be diagnosed with satisfactory certainty

A second mechanism, however, that is certainly of importance, and particularly during recent centuries, is the break up of isolates (Dahlberg, 1948) If susceptibility to tuberculosis is conditioned by recessive genes, the break up of isolates should cause the disease to become more infrequent, since the frequency of allelic genes in duplicate doses thereby decreases Another way of expressing the same thing is to say that the break up of isolates decreases the frequency of consanguineous marriages, and thereby also the frequency of homozygotes

Such a mechanism must clearly have played some part, particularly in countries with a more highly developed and extensive industry where cities have grown at the expense of the rural population Therefore, it seems natural that England should have a lower tuberculosis mortality than Sweden and Norway, regardless of whether English anti-tuberculosis measures are superior or not Conversely, the high Finnish death-rate from tuberculosis has probably something to do with less extensive break up of isolates in Finland than in other countries, though less developed preventive measures and care for the patients may also make a difference Denmark's low tuberculosis death-rate is probably due to the fact that the one large isolate, the capital Copenhagen, includes the majority of the population In the U S A the low mortality from the disease is consistent with the same view, since the population is so largely composed of immigrants, while a comparatively high tuberculosis death-rate among Frenchmen is consistent with their strong family bonds To a fairly large extent marriages are there arranged by the parents, and the frequency of marriages between cousins is unusually high by comparison with other countries of western Europe In other words, the break up of isolates has probably been less drastic in France than in other civilized countries during the last half-century

It seems that many data fit in with the theory suggested by the author, and that the break up of isolates must have had at least some importance for the lowering of the tuberculosis death-rate in recent times Within Sweden itself, we find signs of the effect of the break up of isolates For mortality from tuberculosis is highest in the northern parts of the country where the isolates are small and comparatively well defined It is lowest, on the other hand, in central and southern Sweden where isolates are larger and patients better cared for If the break up of isolates affects tuberculosis mortality, it should also affect general mortality in so far as the latter is genetically conditioned

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——— (1944b) *Svenska NatFören Tuberk Kvart*, 39, 10
Malthète, R , (1946) *Rev Tuberc*, 10, 302

REVIEWS

The Question of Establishing United Nations Research Laboratories. U N Dept. of Social Affairs, Lake Success 1949 (Available from H M S O) Pp 290 (10*s*)

In October, 1946, the French delegation to the Economic and Social Council of the U N submitted a draft resolution which pointed out that a number of research activities can only be carried out in an efficient manner on an international scale, and suggested that an inquiry should be made into the problem of establishing U N research laboratories Accordingly the Secretary-General sent out several hundred letters to various organizations and prominent scientists seeking their opinions on the general principle of U N research laboratories

This report contains a summary of the opinions given (28 pages) and annexes containing individual memoranda and reports (257 pages) In brief, there was a widespread opinion that it would be proper for the U N to establish research laboratories and that astronomy, meteorology, geophysics, infectious diseases, nutrition (especially in relation to agriculture), and the social sciences (especially social psychology), among others, would be proper activities for such international laboratories Although the principle has been widely accepted as sound, many practical difficulties confront those who would attempt to set up such international laboratories and some of these are set out in the annexes The problem of finding suitable staffs would be very difficult, especially in view of the fact that in all countries of the world national and university laboratories suffer from a scarcity of trained and experienced research workers If U N laboratories are set up, it is clear that they must be on a small scale if they are not to reduce seriously the efficiency of other organizations At the start it might be proper for a large proportion of their time and resources to be devoted to the training of research workers and thereby to the creation of their own special staffs A large research programme without a corresponding teaching and training programme could only further disturb the balance between the demand and the supply of trained scientists *R Passmore*

Mongolism (Peristatic Amentia) By M ENGLER, M D 1949 John Wright, Bristol Pp 208+VIII, 28 plates, 12 figs, 24 tables (21*s*)

Perhaps the most interesting and useful part of this monograph is that containing the author's own observations on the physical and mental peculiarities of his mongolian patients This is supplemented by a comprehensive review of the pathology of the condition, collected from the literature, and lavishly illustrated by photographs, figures and tables In addition, the author has tried to produce a summary of all that has been published on the subject, and an attempt to show that there can be only *one* explanation The italics are his His aetiological chapter is the least satisfying. He passes in review all the hitherto suggested theories of causation, and shows that they rest on very flimsy foundations He accepts the high correlation between incidence and advanced age in the mother, and produces additional evidence from his own cases His conclusion is that mongolian idiocy is produced by the implantation of a normal ovum in a diseased uterine mucosa This seems to be little more than another way of saying that the older the mother, the more likely is the child to be a mongol It would be better to say frankly that the aetiology is unknown

Dr Engler regards the traditional appelation, mongolian idiot, as incorrect and misleading, and unworthy of our race, and suggests "peristatic amentia" By peristasis, he understands the total of all harmful factors acting on the ovary and the uterus A new name would have a much greater chance of acceptance if it were more colourful and less suggestive of an unproven aetiological theory

B Woolf

Owing to the steadily increasing cost of production, it has been found necessary to raise the price of the BRITISH JOURNAL OF SOCIAL MEDICINE, beginning with the first issue of 1950 The yearly subscription will then be 30s (U S A 5 dollars) Single copies remaining at 7s 6d each

ABSTRACTS

(This section of the JOURNAL *is devoted to selected abstracts of articles on social medicine appearing in the current literature The section will be edited in collaboration with the two abstracting Journals,* Abstracts of World Medicine *and* Abstracts of Surgery, Obstetrics and Gynaecology)

Problems of Ageing and Chronic Sickness THOMSON, A P (1949) *Brit med J*, 2, 243

This is the first of two Lumleian Lectures delivered before the Royal College of Physicians of London

In the Birmingham Hospital Region of 4,200,000 people, 45 per cent. of the 12,740 general medical and surgical beds are reserved for the aged and chronic sick. The buildings housing them are old and ill equipped For every 100 "chronic" beds, 61 people (excluding medical and laboratory staff) are employed

The lecture is based on work carried out at the Western Road Infirmary in Birmingham—the largest of these institutions Only five medical officers were available for the 1,450 patients, 1,000 of whom were bedridden as well as for the work of a large venereal diseases clinic and a small maternity unit Yet diagnosis and treatment were of a high order, though case records were poor Rehabilitation services, occupational therapy, and physiotherapy were not provided Although only 226 nurses were available and 457 of the patients were incontinent, the general cleanliness of the wards and the condition of the inmates profoundly impressed the author, who pays high tribute to the nursing staff He comes to the gloomy conclusion that most of the present inmates could never be improved sufficiently to return to their own homes The reasons are (1) absence of therapy for degenerative and genetic diseases, (2) incontinence, and contractures and foot deformities induced by neglect and long confinement to bed (3) profound personality deterioration consequent on long hebetude

Records of 714 patients were analysed, of whom 318 were men and 396 women Their average ages were 74 and 76 respectively, 49 per cent of the males and 60 per cent of the females were bedridden Only 56 men and 13 women were fit enough to be allowed out Of the 394 bedridden patients 95 per cent were judged to be beyond all hope of rehabilitation Only 15 per cent. had been investigated in a general hospital before their admission to the institution Of all patients, 25 per cent were certifiable as insane, and no less than 71 per cent were mentally abnormal Much of this psychiatric disorder is due to the institutional atmosphere As regards status, 20 per cent of the men and 16 per cent of the women were single 22 per cent. of males and 11 per cent of females were married with spouses still alive Widowers constituted 58 per cent and widows 73 per cent —figures significantly higher than those for the same age groups in the general population from which it is inferred that the risk of married people ending their days in an infirmary is lower so long as the partner remains alive

The mean duration of stay was 34 months for males and 37 months for females An analysis of the fate of the 2,478 patients admitted in 1946 revealed the following (1) 32 per cent died within 4 months, and a further 7 9 per cent within 2 years (2) 47 1 per cent. were discharged in less than 4 months and a further 7 9 per cent within 2 years, (3) only 5 per cent remained in hospital 2 years after admission Of this residual 5 per cent the ratio of men to women was 1 to 3, although the ratio on admission was approximately 3 to 2 Men are admitted at an earlier age than women Of 958 deaths in 1948, 68 per cent had occurred within 100 days of admission Comparison of the discharge rate with the Orsett Lodge Hospital figures (Cosin, *Proc R Soc Med*, 1948, 41, 333) suggests that, in discharging an elderly patient, home conditions play a greater part than physiotherapy No less than 37 per cent of admissions were for social and not medical reasons—lending support to Brooke's suggestion (*Lancet*, 1949 1, 462) that social services be organized by the hospital to care for the elderly in their homes Of the patients, 33 per cent were unwilling to leave the infirmary under any circumstances, and the degree of unwillingness was proportional to their length of stay, of those admitted within 3 months, two-thirds were eager to go home, but only one third after 4 years' stay As many as 57 per cent. had no home to receive them, and of those with a home available 56 per cent would be compelled to live completely alone or deserted for long periods During the first 3 months about two-thirds have a home to go to, but after 4 years' stay three out of four homes have disintegrated—"manifestly the cohesion of the homes of the elderly is fragile"

The rest of the lecture is a reasoned argument concluding that people should be encouraged to tend their sick and elderly at home The aim should be to reduce the demand for institutional care, which however, should always be readily available *P D Bedford*

Medical Resurvey of Nutrition in Newfoundland, 1948 AYKROYD, W R, SEBRELL, W H, JOLLIFFE, N SHANK, R E, LOWRY, O H, WILDER R M TISDALL F F, MOORE, P E, and ZAMECNIK, P C (1949) *Canad med Ass J*, 60, 329

In 1944 a nutritional survey of the people of Newfoundland was carried out by a group of physicians The same group [without four of the original members and with two newcomers] surveyed in 1948 the same number of subjects (868), including 227 individuals who had been examined in 1944 the present publication [which has no summary] describes the results

Between the two surveys the wealth of the inhabitants had greatly increased and specific efforts to improve nutrition—such as addition of three members of the vitamin B complex to bread distribution of cod-liver oil and orange juice and an educational programme—were made There was a striking reduction in infant mortality and stillbirth rates

In general there was a lowered incidence of the clinical signs recorded but there was an increased incidence of the following perifolliculosis red hyperaemic gums swollen gums, severe active caries [despite fortification of bread with calcium and distribution of cod liver oil] marked or complete loss of teeth loss of vibratory sense

in toes [The authors fall into error over perifolliculosis, which they correctly describe as 'proliferation and engorgement of capillaries around hair follicles" but then confuse with follicular hyperkeratosis when they twice quote three groups of authors as suggesting that deficiency of ascorbic acid may produce the lesion]

Estimations of five blood constituents and two urinary constituents were carried out on nearly half the subjects chosen at random, including 30 per cent of the subjects examined in both the 1944 and 1948 surveys There was little change between the two surveys in haemoglobin values or levels in serum of protein or alkaline phosphatase [which is difficult to assess because the figures were analysed under different age-groups in 1944 and 1948] a slight fall in ascorbic acid level, an increase in vitamin A concentration, and an increased excretion of aneurin and riboflavin [Confidence in the biochemical results is not inspired by the inaccurate way in which they are presented Comparison of the results for 1944 as published previously and as repeated in the present paper reveals discrepancies seven of the nine figures for haemoglobin do not agree, and in the present results the sum of 258 and 117 is given as 385] *H M Sinclair*

Simultaneous Surveys of Food Consumption in Various Camps of the United States Army SCHOR, H C, and SWAIN, H L (1949) *J Nutrit*, 38, 51

Between May 22 and 28, 1945, 44 Army messes, chosen as representative of the Army in the United States, were subjected to food consumption surveys Kitchen waste and plate waste were segregated by food groups, but no attempt was made to determine the amount of food consumed outside messes Only 5 per cent of the food issued to messes was wasted Despite the omission of food consumed outside messes, the dietary allowances of the National Research Council were amply met. There appeared to be no correlation between caloric intake and bodily activity, environmental temperature, and altitude *H M Sinclair*

Food Consumption of Soldiers in a Subarctic Climate (Fort Churchill, Manitoba, Canada, 1947–1948) SWAIN, H L, TOTH, F M, CONSOLAZIO, F C, FITZPATRICK, W H, ALLEN, D I, and KOEHN, C J (1949) *J Nutrit*, 38, 63

The voluntary consumption of garrison troops at Fort Churchill was estimated during three 10-day periods in the winter of 1947–48 The location was chosen because it has about the highest wind-chill value of any inhabited area The troops spent about 3 hours daily in the open Food consumed in messes was recorded, and kitchen waste and plate waste were weighed An attempt was made to estimate canteen food An abundant ration of fresh and frozen food was provided averaging 5,500 Calories per man per day All nutrient intakes equalled or exceeded the recommended allowances of the National Research Council for an active man Continuous weight records of a small number of men showed a slight mean rise during the period

The important conclusions of this interesting study are (1) the caloric intake was inversely correlated with the mean environmental temperature (2) the caloric intake was directly correlated with the mean wind-chill, (3) there was no preference for fats in the subarctic climate the percentages of Calories provided by protein, fat, and carbohydrate were about the same as those in temperate climates, being respectively 13 40, and 47 per cent [the last two figures appear to be given wrongly in the summary as 41 and 46]

It seems that troops regulate their food intake in relation to the severity of the weather, but that their appetite for particular foods is not altered *H M Sinclair*

Epidemic Typhus in Southwestern Arabia PETRIE, P W R (1949) *Amer J trop Med*, 29, 501

An outbreak of typhus is described which occurred in the Yemen in 1940 and continued in some districts of south-western Arabia up to 1946 Typhus has not previously been reported in Arabia It is possible that it had been smouldering there for years or even centuries the author himself saw some suggestive cases and also some relapsing fever in 1937 and 1938, on the other hand, the infection may have reached the Yemen recently from Ethiopia The outbreak originated in San'a, the capital, where a British medical mission worked up to the autumn of 1943 There was a grave risk of spread into Aden via the ancient Jewish community of San a, of which many members trekked westward in 1943 and 1944, encouraged by rumours that Palestine would welcome them as immigrants, stringent quarantine measures had to be initiated for them Aden was further threatened by the spread along the three trade routes from the Yemen, across the Western Aden Protectorate, and it was decided to shut the colony off by a 'cordon sanitaire" along which dusting stations were established

The author describes the great difficulties encountered in the execution of preventive measures, through the inaccessibility of some of the infested areas as well as through the lack of co-operation shown by some local rulers He stresses the need for continued watchfulness, and for a long term programme of prophylaxis *W G Harding*

A Contribution to the Epidemiology of Poliomyelitis in New Zealand THOMPSON, A W S (1949) *J Hyg, Camb*, 47, 79

The author describes a field investigation into an outbreak of poliomyelitis in the central district of Auckland in which 142 cases occurred between October, 1947, and March, 1948, particular attention was given to the occurrence of related minor illness among the household contacts of 40 positive cases and in other persons in the neighbourhood, as compared with that among individuals in a comparatively unaffected control area of similar social and economic type (about 300 houses with 1,100 occupants were visited in test and in control areas), the 'minor illness" accepted as related was characterized by one or more of the following symptoms fever, headache, sore throat, vomiting, diarrhoea, and sometimes pains in abdomen and neck In the homes of positive cases, these suspect illnesses" in contacts were found to bear a close inverse relation to the positive cases in the same age and sex groups The monthly incidence of such suspect illnesses" varied with the incidence of poliomyelitis in the over-all ratio of 300 to 1, but even at the height of the epidemic only about 22 per cent. of the most heavily attacked male age-group (5 to 10 years) were affected Findings are listed which suggest that escape from attack is not primarily due to immunity gained in a previous epidemic [this view is in accordance with the findings in a recent study of the age-distribution of poliomyelitis in successive epidemics in New York in 1934, 1935, and 1944]

Other points established were that the "suspect illnesses" increased in number before the epidemic, that there was no spread from any particular focus that a high proportion (50 per cent of males 10 to 15

years old, and of females 5 to 10 years old) of the household contacts of positive cases had a suspect illness' during the period of observation, and that these suspect illnesses" in the general population followed the poliomyelitis pattern in age and sex incidence Attention is drawn to the fact that threadworm infestation and poliomyelitis have a similar age and sex incidence and to the ready recovery of threadworm ova from the dust of infested households a reminder is given that the virus of poliomyelitis is excreted in the faeces, and it is suggested that indoor dust spread, in schools in particular, may touch off an epidemic in a population ripening for it

The author is impressed by the important role which his findings suggest is played by the older schoolboy in spreading infection He stresses the likelihood that faecal organisms, rather than droplet infection, are of major importance in propagating the disease and emphasizes the supreme importance of personal hygiene among the general measures of control, coupled with the avoidance in epidemic times of all functions at which children assemble, use closets in common, and take food together *F T H Wood*

The Epidemiology of Poliomyelitis with Particular Reference to the County of Dorset and the 1947 Epidemic. GILLORAN, I L (1949) *Med Offr*, 81, 255

This paper gives a description of the past history of poliomyelitis in Dorset, with details of experience in the county in 1947 An account is quoted of an outbreak at Wimborne and in the Beaminster rural district in 1914 when sixteen persons appear to have been attacked Since 1914 the disease does not seem to have aroused comment so far as Dorset is concerned, though 21 cases were notified in 1945 In 1947 there were three notifications in January and two early in June, but the epidemic really began with five cases (one fatal) in a preparatory school in the Wareham Rural District which occurred between June 29 and July 4 Altogether there were 65 cases in the county (attack rate 25 per 100,000), 43 of which occurred in the Poole, Wimborne, and Blandford areas The first case in Blandford occurred on August 1 in a boy aged 3½ whose brother, aged 13, returned home from the school mentioned above on July 26 this boy had not been ill at school There were four more cases in Blandford between August 21 and 28 A follow-up study of 60 of the 65 patients showed that 25 (41 6 per cent.) had no paralysis, nine (15 per cent) had slight paralysis, 21 (35 per cent.) had permanent paralysis and five (8 3 per cent.) died The epidemiology of the disease is discussed in general terms

[A small outbreak of poliomyelitis at the village of Cerne Abbas, Dorset, in 1910 was described by Farrar in *Reports to the Local Government Board on Public Health and Medical Subjects* (*New Series*), No 61 1912 This outbreak is of some interest as it was one of the earliest to be described in Great Britain and was remarkable for a very high attack rate—15 paralytic cases in a small village, with multiple attacks in three households There were three cases in one household, and two in each of two others] *A H Gole*

The Enigma of Notified Dysentery II GLOVER, J A (1949) *Mon Bull Min Hlth* 8, 138

In a previous paper (*Mon Bull Min Hlth* 1947 6, 46) the author reviewed the incidence of dysentery as measured by notifications in England and Wales between 1925 and 1946 He called attention to the enormous increase in notification which began in 1925, proceeded slowly for 11 years, and then, with three major bounds in 1927 1941, and 1944, rose to a peak of 16,278 in 1945—an incidence 47 times as great as in 1925 the year of the fewest notifications since the war of 1914–18 It was significant that this enormous increase in notification had been accompanied by but a trivial increase in deaths, which numbered 135 in 1925 and 165 in 1945

In the present paper he records that after the great peak of notifications in 1945 there was a decline in 1946 to the nadir in 1947, since when there has been a rise He tabulates the frequency with which organisms causing bacillary dysentery were isolated by the Public Health Laboratory Service during the period 1945–48, and concludes that the fluctuation in incidence, manifested as two waves separated by a trough was due to Sonne dysentery, although Flexner infection had shown a somewhat similar contemporary variation on a much smaller scale

Several remarkable features are reported For example, male infants and young boys showed higher attack rates and much higher case mortality rates from dysentery than did female infants and young girls whereas in the aged these sex ratios were reversed The geographical distribution of notifications was remarkable For example, during the peak year five Welsh counties returned no notifications and only one case was notified between the five counties in the following year After 1941 London had a higher attack rate than the rest of England, and Lancashire also had a high incidence On the whole rural districts had higher rates than English county and non-county boroughs and urban districts The scattered distribution of short localized dysentery epidemics appeared to be haphazard The author is unable to offer any explanation of these variations The environmental and material factors which in his earlier paper he had tentatively suggested as possible causes seem no longer to serve as even a partial explanation, because they have remained, for the most part unchanged throughout *H H Bradley*

Filariasis Control by DDT Residual House Spraying, Saint Croix, Virgin Islands I Operational Aspects KOHLER, C E (1949) *Publ Hlth Rep Wash* 64, 857

Whereas the literature concerning the control of anopheline by residual spraying with DDT is extensive that concerning control of culicines by similar means is scanty and the author's account of an attempt to control *Culex quinquefasciatus*, the local vector of *Wuchereria bancrofti* in the Caribbean region appears to be the first of its kind to be published

The work was carried out on the island of St Croix Virgin Islands the population of which in 1940 was 12,902 In 1946 surveys showed that *W bancrofti* larvae were present in the blood of 13 3 per cent of 1 311 school children examined while concurrent mosquito surveys revealed that 7 9 per cent of 2 244 specimens of *C quinquefasciatus* and 2 3 per cent of 567 specimens of *Aëdes aegypti* were infected This high filarial infection rate in the human and insect populations was associated with a low economic standard of living among the inhabitants of St Croix, where piped water supplies to dwellings were rare and where in 9- per cent of the houses water was stored in cisterns and [illegible] containers Only 5 per cent of the population had flush-down closets and *C quinquefasciatus* was known to breeding in the polluted water in the privies and in the stored water already referred to In October 1 a DDT-spraying programme was [illegible]

the period October, 1946, to June, 1948, four sprayings were carried out, the number of houses sprayed on each occasion varying from 2,530 to 2,934 The most satisfactory spray used was a 25 per cent. emulsion of DDT in xylene with "triton X—100" as emulsifier, diluted to 5 per cent. with water Walls, ceilings, porches, and privies of living quarters and schools were sprayed to give 200 mg of DDT per sq ft. (2 15 g per sq m) The author recommends that in the future two complete sprayings should be carried out each year by a spray crew consisting of one foreman and two sprayers

II Results BROWN, H W, and WILLIAMS, R W (1949) *Publ Hlth Rep, Wash*, 64, 863

The second paper deals with the results of the filariasis control measures described above The original intention was to observe the results over a period of 5 to 10 years, but after 2 years of the spraying programme control of filariasis through the treatment of every individual on the island was instituted by another research group, and it was considered impossible to continue to assess the effect of DDT residual spraying alone The authors' estimate of the effectiveness of the campaign rests on mosquito surveys and on nocturnal blood surveys of the school population made before and after the 2 years of spraying A vigorous campaign against anophelines undertaken in 1934 had virtually eliminated malaria transmission, and only two species of mosquitoes, *Culex quinquefasciatus* and *Aëdes aegypti*, were found The mosquitoes were collected in houses by means of an aspirator, brought to the laboratory, dissected and examined for the presence of filariae, larvae found in the head and proboscis being classed as infective The authors discuss the possibility that the filariae found in the mosquitoes might have been derived from some other source than the human population, and reach the conclusion that it is reasonably safe to assume that the larvae encountered were those of *Wuchereria bancrofti* Whereas of the 2,244 *C quinquefasciatus* caught in the houses in 1946 7 9 per cent were infected and 0 4 per cent. contained infective forms, in 1948 after the sprayings, only 846 *C quinquefasciatus* were collected, of which 3 65 per cent. contained developing forms, none of which had reached the infective stage The authors suggest that this mosquito does not live long enough in the presence of DDT for the complete development of the microfilariae to the infective form.

Of the 1,311 children examined in 1946, 13 3 per cent. were found to harbour microfilariae, after 21 months of DDT spraying 961 children were examined, with an infection rate of 10 6 per cent

The authors discuss in considerable detail the significance of these findings and of the mosquito survey already described [and their paper should be consulted in the original by those interested] They summarize their results as follows "(1) The population of *Culex quinquefasciatus*, the vector of filariasis, was reduced by approximately 50 per cent in the houses (2) The number of houses in which *C quinquefasciatus* could be found was reduced by 57 per cent (3) There was a 50 per cent reduction of *C quinquefasciatus* containing forms of *W bancrofti* which had advanced in development beyond the ex-sheathing of the microfilariae (4) Before the spray program, 0 40 per cent of all *C quinquefasciatus* examined harbored infective stages of *W bancrofti* After the spray program not a single infective stage larva was found in any mosquito (5) *Aëdes aegypti* was completely eliminated from the houses (6) The *W bancrofti* infection rate in school children dropped from 13 3 per cent. to 10 6 per cent during the spray program, and the average microfilaria count fell from 74 1 per 0 04 ml of blood to 45 8 The differences are not quite statistically significant by conservative criteria (7) Of 504 children examined in 1946 and again in 1948, a total of 454 were negative both times Twenty individuals experienced increases in microfilaria counts, averaging 14 per 0 04 ml. of blood, while the counts of 30 individuals decreased an average of 46 per 0 04 ml during the spray period" *R M Gordon*

Social Factors in Obstetrics BAIRD D (1949) *Lancet*, 1, 1079

The highest grade of reproductive efficiency means high fertility, very good health, a sense of well-being during pregnancy, freedom from any of the recognized complications, spontaneous delivery of a live and vigorous child, normal involution, and successful lactation How far short of this standard any particular person may fall, and why, is very difficult to determine accurately For the nation as a whole, maternal mortality rates give a fair index of this efficiency However, for a comparison of its variability in different social classes the figures would be too small for any satisfactory conclusions to be drawn, and though the mortality in the first 12 months of extra-uterine life is a most delicate index of living conditions, yet in dealing with reproductive performance mortality is less helpful and sometimes even misleading

Foetal deaths (stillbirths and neonatal deaths) are influenced by much the same factors as those affecting maternal mortality, and the rates have been compared between a group of 876 consecutive primigravidae in a nursing home, a second group of 450 in a second nursing home where the fees were lower, and a third group of 876 out of 3,600 booked primigravidae in the Aberdeen Maternity Hospital Each of these groups was further subdivided according to height The women in the hospital group were, on the whole, shortest, 26 per cent. being under 5 ft 1 in (155 cm.) tall Those in group one in the more expensive nursing home, were the tallest, only 5 per cent being under 5 ft. 1 in. in height The patients were further subdivided into age groups and it was found that the foetal mortality was highest in the shortest and oldest patients, and the mortality rate for comparable patients in the nursing home and hospital groups was highest in the latter [Assessed by Caesarean section rates, results are better in hospital than in private practice]

The highest standard of reproductive performance is attained in the small group of tall young women under the age of 25 in social classes one and two Further intensive study of small groups will be required to investigate the correlation of reproductive performance with such factors as intelligence, personality, nutrition, family income, and standards of obstetrical care *D M Stern*

The Effect of Smallpox Vaccination During Pregnancy on the Incidence of Congenital Malformations GREENBERG, M, YANKAUER, A, KRUGMAN, S, OSBORN, J J, WARD R S, and DANCIS, J (1949) *Pediatrics*, 3, 456

In view of the fact that rubella occurring in the first 3 months of pregnancy has been alleged to cause an increase in the incidence of congenital foetal abnormalities, and of the fact that vaccinia, like rubella, is a generalized virus infection the authors investigated the offspring of women who had been vaccinated during pregnancy, the opportunity for a large series of such cases

being presented when 5,000,000 persons were vaccinated in New York in 1947 following an outbreak of variola

The investigation was carried out at 67 child health stations and 11 hospitals, the children of all women who were in the first 3 months of pregnancy at the time when the widespread vaccination took place being examined for congenital abnormalities The children of those who had not been vaccinated at that time thus served as a control group The abnormalities for which search was made included congenital heart disease, mongolism, cleft palate and hare lip, spina bifida, microcephaly, micrognathia, etc Club foot, hydrocele, hernia, and haemangioma were not included in view of the doubt existing as to whether these were congenital abnormalities or deviation from normal It was found that 4,172 vaccinated women gave birth to 68 malformed infants, an incidence of 1 63 per cent, while 2,186 unvaccinated women gave birth to 30 malformed infants, an incidence of 1 37 per cent The difference in incidence is not statistically significant The incidence of prematurity was 8 2 per cent in the vaccinated group and 8 4 per cent in the unvaccinated group

Since many congenital abnormalities result in early death, the neonatal death rate from congenital abnormalities in the City of New York during a period which would include all those infants of 0–3 months foetal age at the time of the widespread vaccination was calculated and found to be 48 8 per 10,000 live births, for the corresponding period in the preceding year the rate was 47 2 per 10,000 live births, the difference being again not statistically significant Similarly, no significant increase could be found in the incidence of stillbirths during the relevant period *P T Brai*

Studies on Products of Human Abortion with Special Reference to Early Malformations and their Causes (Studien an menschlichen Aborteiern mit besonderer Berücksichtigung der frühen Fehlbildungen und ihrer Ursachen) KAESER, O (1949) *Schweiz med Wschr*, 79, 509

The author studied 606 cases of abortion occurring during the first 28 weeks of pregnancy —(1) to determine the relative frequency of malformation of the ovum as a cause of abortion and (2) to decide whether arrested development is to be ascribed to factors inherent in the ovum or in the mother, or if both may have the same effect

After reviewing the literature and enumerating possible causes of miscarriage and difficulties of differentiation even on laboratory examination the author gives normal embryological data and his own statistical results He finds that, of all abortions maternal causes are responsible for 29 2 per cent, criminal causes 24 8 per cent and ovular causes 35 4 per cent In the last group moles are the most frequent finding Ovular causes of spontaneous abortion amount to about 50 per cent The classification according to age shows a nearly linear increase in the incidence of moles from 25 to 30 per cent at age 20 to more than 50 per cent at age 40 or over

Relative to the number of earlier pregnancies births, and miscarriages, the distribution of abortions due to foetal malformations is similar to that of abortions generally the majority appear during the first pregnancy after the first birth, or after the first miscarriage After the second pregnancy such abortions rapidly become more and more rare with increasing parity As malformed ova appear irregularly before or between normal pregnancies, the author concludes that after a mole pregnancy" a woman is no less likely to conceive or to complete a pregnancy normally than after an abortion due to other causes *F A Jacobs*

51 Fatal Cases of Abortion (Criminal) in Rio de Janeiro (Em torno de 51 casos de abortamentos mortais (criminosos) no Rio de Janeiro) BARROS P (1948) *Obstet Ginec lat-amer*, 6, 517

The author describes each of the 51 cases including the post-mortem findings The entire problem of criminal abortion is reviewed from the medical and legal point of view in the light of the modern and very precise Brazilian criminal law The predetermining factors are discussed and classified into social, moral, economic and aesthetic An important medico-legal point is raised by the author when he stresses the possible existence of physiological or pathological contributory causes—such as an abnormally placed or mobile uterus, ectopic pregnancy or vulvo-vaginal infection—liable to aggravate the outcome of an attempted criminal abortion *A Lilker*

Malarial Immunity in Africans Effects in Infancy and Early Childhood GARNHAM, P C C (1949) *Ann trop Med Parasit*, 43, 47

The observations on which this study of malaria in very young children is chiefly based relate to an African tribe the Luo, living in a highly malarious region around the Kavirondo Gulf of Lake Victoria and possessing a considerable degree of natural and acquired resistance to the disease After a brief reference to congenital malaria and abortion in infected women, the author deals with the incidence and morbidity in young children and the mortality and pathology of the disease in infants He found no congenital malaria in 146 infants of infected mothers, and only 19 of 124 women who aborted had malarial parasites, but in another small group of less resistant women who aborted a far greater proportion had malaria, and this was an important causative factor in abortion In the Luo tribe stillbirths were few and were rarely due to maternal malaria

The incidence of malaria in infants steadily rose from about 10 per cent in the first 2 months of life to about 90 per cent at one year the number of parasites in the peripheral blood fell from 48 per 50 microscopical fields in the first 6 months of age to 18 from 6 months to 3 years and 9 from 4 to 10 years The symptoms were usually mild and the general health and nutrition were almost unaffected a critical examination of 52 fatal cases ascribed to malaria showed that only 17 could actually be attributed to that disease Among 75 children specially examined periodically during 2 years only one died of malaria In fatal cases the liver showed excessive proliferation and swelling of the Kupffer cells and the blood vessels were engorged with lymphoid macrophage cells in all stages of development capillaries in the brain were blocked by swollen proliferating endothelium and wandering histiocytes or by schizonts [Photomicrographs of liver and brain section are shown] The heart muscle presented similar appearances but other organs were less affected Exoerythrocytic forms of the parasites were sought without success

The author discusses his findings and compares them with those of workers in other malarious regions He emphasizes the influence of immunity (transplacental from the mother and acquired) which exists in endemic areas whereas where endemicity is low and passive immunity are short and [illegible] until resistance is acquired *J F C*

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